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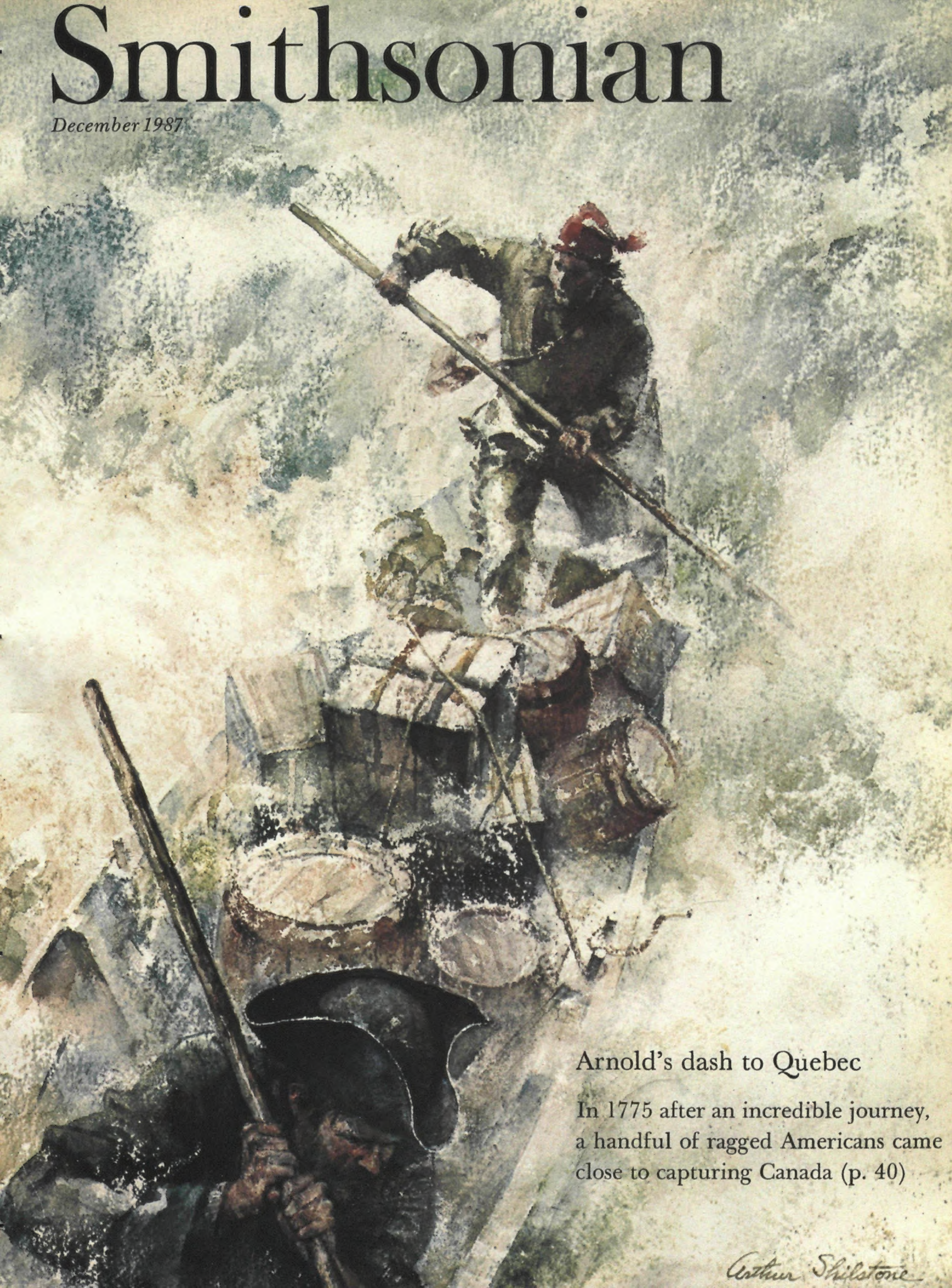
December 1987



Arnold's dash to Quebec

In 1775 after an incredible journey, a handful of ragged Americans came close to capturing Canada (p. 40)

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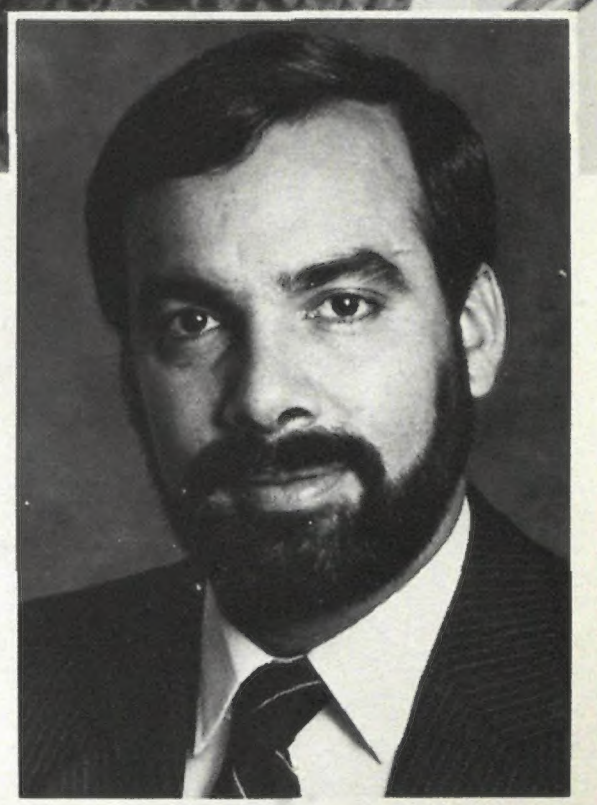

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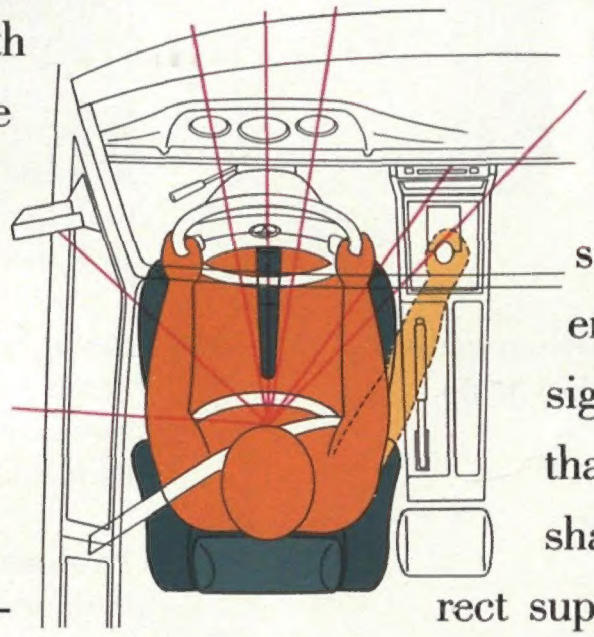

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Volume 18, Number 9

Table of Contents

Cover: Headed for the siege of Quebec, American soldiers struggle to keep their leaky bateau afloat (p.40)
Illustration by Arthur Shilstone

10 *Smithsonian horizons* by Secretary Adams
14 *Letters to the Editor*
20 *Picture credits*
22 *Around the Mall and beyond* by Edwards Park
30 *Phenomena, comment and notes* by John P. Wiley jr.

40 **'Don't give up! Go on boys!'**
Hit in the leg, Benedict Arnold urged his men to storm British-held Quebec—but odds were against success
By Edwards Park, illustrations by Arthur Shilstone

52 **Charles L. Tiffany: a life of luxuries**
He cofounded the store where customers from Abe Lincoln to Elizabeth Taylor have browsed for baubles
By Daniel Cohen

68 **A prolonged close call for alpine ibex**
Only about 50 remained when a forester in the Italian Alps sounded the alarm in 1821; now there are thousands
By Caroline Grodinsky and Michael Stüwe

80 **The possession of Ralph Blakelock**
Driven mad by poverty, his art acclaimed too late, he spent his final years controlled by a willful woman
By Abraham A. Davidson

94 **Exploring the ends of the Earth**
Not storms or bandits or vipers deterred Roy Chapman Andrews' motorcar expedition through Central Asia
By Douglas J. Preston

108 **It's ancient, it's labyrinthine . . .**
. . . everyone knows where it starts; no one knows where it ends. A clue? Just ask the English and Japanese
By Richard Wolkomir
Photographs by Bryan and Cherry Alexander

122 **Using chaos to make order**
Stock prices, heart twitches, global stress: confused systems all, but the new science of chaos may help
By James Gleick, photographs by Yoav/Phototake

138 **Winter is when you get the sled out**
And if a buddy's backyard harbors a wee mountain, you belly-whop on one of Man's first vehicles (and toys)
By Peter Stark

152 **El Escorial, the regal retreat**
As the 16th century's richest man, Philip II of Spain built a splendid palace-monastery that still dazzles
By Robert Wernick

166 ***Boom!* 'Wazzat?' 'Just art'**
In the New Mexico desert, sculptor Evelyn Rosenberg uses explosives and metal to create rare beauty
By Richard Wolkomir, photographs by Ovak Arslanian

175 **The anatomy of a headache**
With new technology, researchers pursue its causes as they look inside the skull to see how pain develops
By Edwin Kiester jr.

194 *Book reviews*
204 *Additional reading*
206 *December events at the Smithsonian*
210 *Smithsonian tours and seminars*

212 **Learning one's letters from Mme. la Comtesse**
By Rudolph Chelminski

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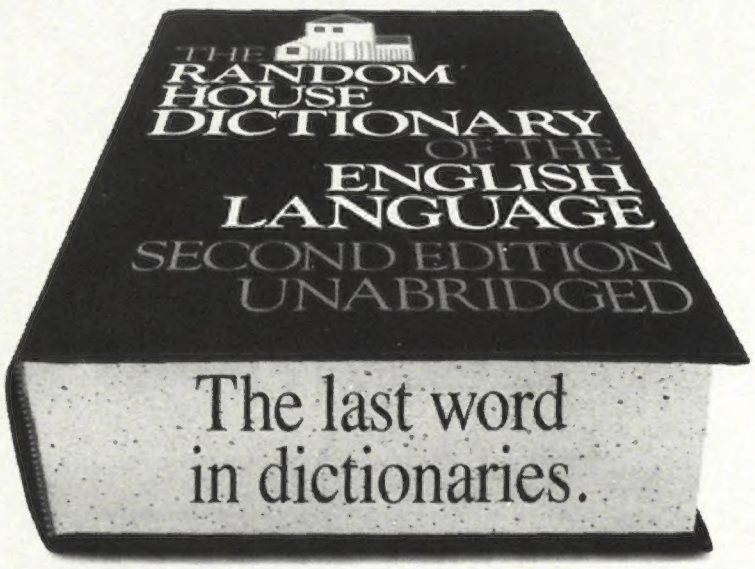

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Secretary Adams' comments

Smithsonian horizons

The search for a common heritage through the study of ancient civilizations has become a truly international effort

There may have been occasions when small and isolated peoples, perhaps on an island, were overwhelmed and completely destroyed by some calamity. Civilizations, on the other hand, may even survive life on this planet. More or less by definition, all of them are (or were) large, complex and long lasting. Even the oldest civilizations erected cities; adorned them with monumental architecture; kept records; supported craft, administrative and ritual specialists; and sought out resources through long-distance trade. The imprint of such routine activities, to say nothing of the flood of ideas and innovations out of which they must have been derived, was both enduring and cumulative.

A less elementary property of civilizations is that they cultivate learning and the retention of memory. Almost from the outset, this must have begun to transform the span of an individual's perception and motivation, his or her attachments to larger social groups, and hence the potential size and complexity of those groups and their capacity for deliberate action. This is surely one reason why Sumerian civilization, arguably the earliest of all and in any case the one which I know best, profoundly and permanently shaped the cultural landscapes of all its neighbors. It is indeed "dead" in the sense that its physical remains are largely buried beneath the later Mesopotamian (now Iraqi) alluvium. In fact, its very existence was reconstructed by modern scholars only after years of dedicated efforts in unearthing and deciphering clay tablets in a long-forgotten language. But how can it be truly dead when its organizational and technological discoveries continue to undergird our lives, and when some of its conundrums and metaphors still resonate in our deepest structures of thought?

These reflections are prompted by recent letters from a colleague in the contemporary world-civilization whose lineality of ancestral descent is longest, richest and most direct. I first met Dr. Zhi Yang in Beijing, where she had finally been able to resume her undergraduate studies and subsequent research as a member of the staff of the World History Institute after an eight-year interruption during the Cultural Revolution. Private support was generously made available in 1981, permitting her to come to the University of Chicago's Oriental Institute as a graduate student in Sumerology and Assyriology. Now she has returned to the People's Republic of China as its first specialist in the language and literate traditions of the sister civilization of ancient Mesopotamia. In the chilly but vibrant Manchurian setting of Northeast Normal University in Changchun, she has joined the faculty of an equally unprecedented Institute for the History of Ancient Civilizations and has been named as its Vice Director.

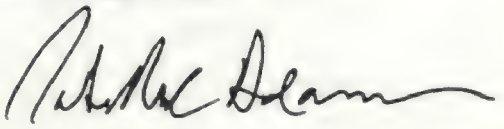
Little more than three years old, this Institute has already established undergraduate and doctoral programs not only in the ancient civilizations of Egypt, Anatolia and southwestern Asia but also in classical Greek and Roman studies. More rapidly to bring this undertaking to fruition, foreign experts have been recruited to supplement the core staff of Chinese scholars. Dr. Yang writes vividly of the organizational efforts familiar to institution builders everywhere, but with far fewer resources in China, that she, her husband David Jacobson (an Egyptologist) and other colleagues are making.

They have already launched a new journal, and made some progress toward more adequate space, computer facilities and support funds for students. High on the list of basic requirements, fortunately now met with winter coming on, was a space heater! Most crucial of all has been establishing the rudiments of a specialized, working library in complex, polylingual fields for which there are absolutely no Chinese counterparts. Support for this last has come from Swiss and West German foundations as well as from Chicago, but much more is needed and would be warmly welcomed.

Many aspects of growing world interdependency are viewed today with fear or skepticism. Currency rates are locked into uneasy competition with one another. Export subsidies and tariff barriers, trade deficits and interest rates are intricately interrelated pieces of a single worldwide puzzle. Gloom or panic on one stock exchange reverberates almost instantly on others. Even the arms race is, in an ironic sense, merely a somewhat pathological form of interdependency.

But let us not forget that there is another, older, more unambiguously constructive and, one hopes, ultimately more significant meaning to international intercourse. The lessons and learning of civilization are humankind's common heritage. Study of the ancient roots of Old World civilizations, most solidly established in Western Europe and North America, also flourishes in the Soviet Union and Eastern Europe and in a number of countries of the Near East and Middle East. Japan, after a relatively late entry, has in a remarkably short time become a major contributor. The pre-Hispanic civilizations of the New World similarly are receiving the attention of growing numbers of specialists, not only in Latin America and North America but in the Old World. As the new Chinese journal recognizes, each of these efforts nourishes and is nourished by others.

So it is profoundly satisfying to learn that China is directing a significant part of its historical and humanistic attention toward parallels or contrasts elsewhere with its own unique record of achievements. With incalculable intellectual and historical resources yet to be drawn upon, China will one day greatly strengthen this truly international discourse.



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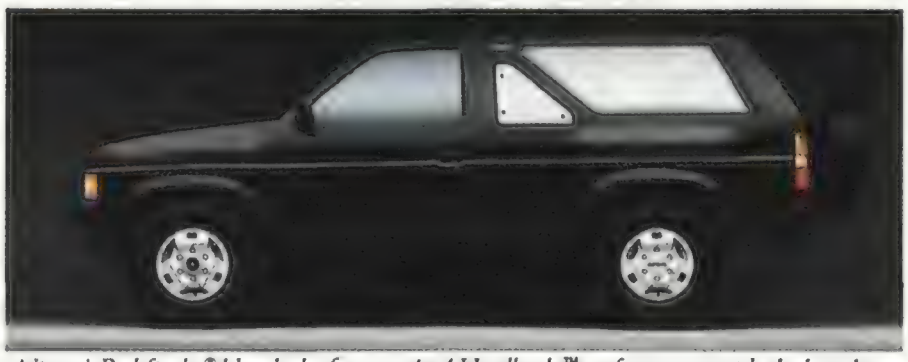

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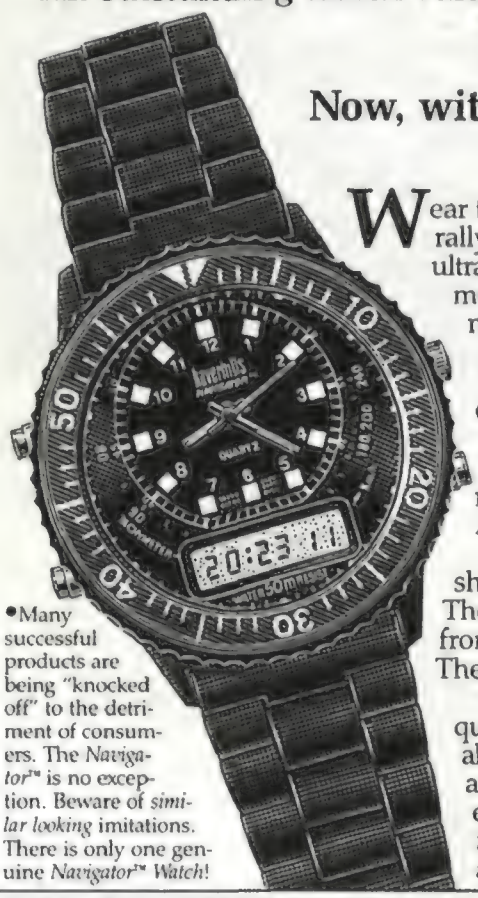

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Letters to the Editor

Everest versus K2

Dear Sir: As leader of the expedition that first climbed K2 in 1954, I was especially interested in your October article telling of George Wallerstein's calculation indicating K2 might be higher than Everest. I quickly organized a group and obtained funding from the National Research Council of Italy to remeasure both peaks, using the most sophisticated satellite technology. Under the scientific guidance of Alessandro Caporali, a physicist at the University of Padua, the team took satellite readings from the Rongbuk Glacier on the Tibetan side of Mount Everest and at the end of the Godwin Austen Glacier south of K2 in Pakistan. Both regions are shown on pages 176-77 of your article. We announced our results in Rome on October 6 of this year: Everest, 29,108 feet; K2, 28,268 feet, and both are close to heights derived from the 1856 Survey of India.

Ardito Desio, Professor Emeritus
Department of Geological Sciences
Milan, Italy

Dear Sir: I am not surprised to see the Survey of India results vindicated. Despite the difficulties encountered in getting the measurements, it was an extremely meticulous and thorough piece of work—one of the most remarkable surveying feats of all time. The spring 1988 expedition to Mount Everest and K2 mentioned at the end of your article will still take place. Using satellite surveying equipment provided by the National Science Foundation, several other geodesists and I will study the plate tectonics forces that created the Himalaya and that have apparently

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Panasonic Video Update

When it comes to shooting in low light, the Panasonic OmniMovie™ PV-320 really shines. But this camcorder can do more than capture your child's smile by the light of one candle.

A Real Show Stopper
The PV-320 has a 1/1000 of a second high-speed shutter that can capture the excitement on your child's face as a roller coaster screams down the track. Or put your golf or tennis game on the right track. Because it can capture every split second of your golf swing or tennis stroke. And show you the results in crystal-clear slow motion and freeze-frame.

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Ordinary camcorders produce a rainbow pattern of noise between scenes. This can be annoying when you shoot something with a lot of scenes, like a Little League game. But the PV-320 has a flying erase head that produces clean, virtually glitch-free edits. So everything you shoot will have a more professional look.

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raised Everest's height by as much as three feet in the past 100 years.
Roger Bilham
Professor of Geology
University of Colorado
Boulder

Dear Sir: About measuring Everest, you say the mass of the Himalaya would tug the leveling bubbles in surveyor's instruments toward the mountains. Since the bubbles are air, wouldn't the pull be on the liquid, thereby squeezing the bubbles away from the peaks?
Tom Booz
Plantation, Florida
Mr. Booz's levelheaded explanation is right on target. Ed.

Camera collector

Dear Sir: This is to respectfully let you know of my objection to the cover photograph. While I agree that it is important to present material that is attention-getting and that promotes interest, I believe the shocking-pink garter and black lace glove and hose seriously detract from what I have always considered to be a scholarly publication. This is one issue of SMITHSONIAN that I do not care to have prominently displayed on the coffee table in my office.
Nancy J. Melton, Ph.D.
Portsmouth, Virginia

Dear Sir: Fake fingernails fit your October cover model as poorly as they fit every other woman. Cannot SMITHSONIAN afford a model with real fingernails?
Jeanne P. Warth
Evanston, Illinois

Dear Sir: Nice gams on the cover.
Bernard W. Rinehart
Portland, Oregon

Dear Sir: The octagonal spy camera on the cover is not the same Petal camera listed in the *Guinness Book of World Records*, as stated in Doug Stewart's article. The camera to which *Guinness* refers was also manufactured in 1948, but by a different company.

A rose is a rose is a rose, but that is not necessarily the case with a Petal.
Irving Zelkind, Ph.D.
Englewood, Colorado

Dear Sir: No self-respecting spy would get caught with the wrong camera! The Minox shown on page 118 is their Model B, manufactured from 1959-71, not the original 1937 model, which was designed and manufactured in Latvia.
Julian C. Light
New York City

Argiope *spiders*

Dear Sir: Michael Robinson's article about *Argiope* spiders was timely, as one took up residence next to our front door about ten days ago. None of our books at home identified her and we hadn't had a chance to get to the library. So imagine the squeals of delight from three kids (and me) when we opened our magazine and found her kin. Now that Fredrika has been properly identified, we are watching her and hoping for babies.
Jana Trent
Colleyville, Texas

Dale Carnegie

Dear Sir: My father-in-law, Frank Self, and Dale Carnegie were close friends in college. Dale always credited Frank as the person who convinced him to give up high school teaching and go into adult education. His tribute to Frank remains in the introduction to Carnegie's first book. My husband's father treasured this friendship and was so glad he had spoken those words.
Dorothy Self
Topeka, Kansas

Combustion

Dear Sir: I was disappointed that writer Fellman failed to mention the work of professors C. Fayette Taylor and Edward S. Taylor at MIT during the latter part of the 1930s. Their book, *The Internal-Combustion Engine*, describes much of their important work in measuring flame velocities and cylinder pressures as well as calculating the gas temperatures at various positions in the cylinder.
Cyrus F. Wood, PE
Estes Park, Colorado

Girl Scouts

Dear Sir: I am distressed by Jane Howard's comment about Kari "who used to want to be a nurse but now thinks that maybe. . .she'll become a physician." This implies that physicians are superior to nurses. We now have a national nursing shortage, forecast to continue and worsen throughout this century, while there is an overabundance of physicians.

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Panasonic Audio Update

Panasonic XBS stereos produce bass so powerful, we dare you to match it. But they have much more to spark your interest.

XBS Goes Boom
The RX-C38 will put more boom in your room. It's a sophisticated 3-piece AM/FM stereo cassette recorder with auto-reverse and a 5-band graphic equalizer. Plus there's a 6-speaker system that's hard to equal. Because two speakers are subwoofers that will generate enough bass to knock you off your equilibrium.

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XBS On A Personal Note
For those who want to experience XBS on a more personal level, there's the RX-SA79. It's an AM/FM personal stereo with multiband graphic equalizer, Dolby,® auto-reverse and specially designed headphones that intensify and magnify bass.

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The nation's health care system desperately needs bright young people (and not just women) to work in the highly technical, demanding and rewarding realm of nursing. Even casual comments such as this are detrimental to the profession, to health care and to the well-being of anyone who ever needs a nurse.
Catherine F. Ryan, R.N.,C.
Seattle

Dear Sir: Not so well known as Juliette Low's love of her uniform is one of her reasons for it: "The uniform puts every girl on the same footing; no finery may be worn by one girl which will excite the envy of another . . ." (from the *Leaders' Manual*, circa 1916).
Eleanor Bacon, Resources Consultant
Maumee Valley Girl Scout Council
Toledo, Ohio

Henry Christophe

Dear Sir: When Christophe took over Haiti, there was no official currency. Searching for an item everyone had access to, he settled on the gourd. All gourds then became the property of the Haitian government and were used in place of coins or bills. The country's primary monetary unit is still called the *gourde*.
Ben H. Jenkins, M.D.
Newnan, Georgia

Dear Sir: Frances Maclean gave 1780 as the date for Henry Christophe's enlistment for the Battle of Savannah. It took place in September and October 1779.
George P. Clark
Louisville, Kentucky

Dear Sir: While La Navidad may have been the first Italian settlement in the New World, it almost certainly was not the first European one. Archaeological work carried out at L'Anse aux Meadows in Newfoundland has established that Vikings settled there briefly sometime between A.D. 900 and 1100.
Harold W. Makinson
San Rafael, California

Lawyers

Dear Sir: Mr. Casson should be reminded that the very group he criticizes protects his right to do so daily and is the first profession to be eliminated by totalitarian regimes.
Albert D. Massi
Las Vegas

Charles Lindbergh

Dear Sir: On page 213, the photograph of Lindy's welcome in Hartford shows him riding in a 1927 Packard touring car that my father loaned to the Hartford organizing committee for the occasion. Close examination of the photo will reveal that the license plate on the front of the automobile was No. 493. This number has remained in our family and now is being used by my sister in Litchfield, Connecticut.
Morton C. Treadway jr.
Bristol, Connecticut

Dear Sir: My late father was asked to sit in the reviewing stand on the day Lindbergh rode through Hartford—and I was born while he was at the parade. While reading the article on Lindy's 48-state tour, my husband remarked: "Here's a picture of Hartford celebrating your birth." I looked at the photograph through a magnifier and sure enough, there's my father with my older brother and sister in the front row. Thanks for giving me and my family a pictorial treat.
Ella F. Norwood
Hartford, Connecticut

Dear Sir: In these 60 years since the Lindbergh flight from New York to Paris, I have wondered how many others still feel the excitement generated by his visit to the 48 states. We were in Portland, Maine, at a small summer hotel. The wife of the hotel owner ran to tell us her husband had just telephoned that they were closing his office so everyone could go to the airport at Old Orchard Beach to see Lindy. We lost no time getting into our car and became part of a real traffic jam.

Somehow, Papa, my brother and I got within four or five feet of Lindbergh, who stood talking to people, holding his left hand on the propeller. I was speechless.

Then, he taxied up the beach, turned around, started back our way and rose from the sand at a point where, as he passed, he turned and waved, smiling, as if we had been old friends.

On the anniversary of his flight this year I brought out my two-inch celluloid model of the *Spirit of St. Louis* and wore it on my lapel.
Robert J. MacLeod
Millbury, Massachusetts

Dear Sir: The Lindbergh tour may have been even more of a feat than has gen-

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For bass you can hear, feel and actually see, just try to match the new Panasonic RX-FW39 XBS portable stereo.

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erally been recalled. The *Spirit of St. Louis* was specially designed for the Atlantic challenge. As a consequence, the aircraft was ill suited for operating in and out of strange, frequently tiny, domestic airfields that were usually crowded with onlookers.

This was evident to me as a child, when I watched the hero land the plane in a converted pasture at Renner, South Dakota, for his Sioux Falls stop. I could see plainly that the pilot's forward vision was virtually blocked by the peculiar cabin construction. Today, after a flying career of my own, I still find it remarkable (and a tribute to Lindy's skill) that the tour could have been concluded without consequential accident.

Warner Clements
Beverly Hills

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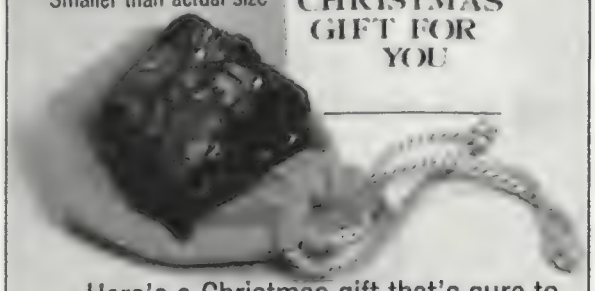

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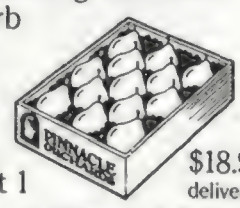

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Around the Mall and beyond

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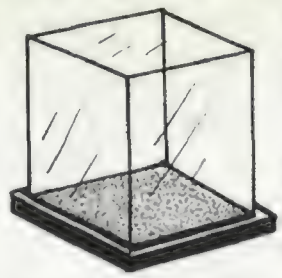
Back in the 1850s, when the Castle, our first Smithsonian building, was new, stoves and fireplaces were considered enough to heat those parts of it where people lived and worked. Secretary Joseph Henry and his family resided in the building, as did a few bachelor scientists. But no radiators warmed the storage and exhibition rooms on the second floor of the Castle's central section.

In 1854, the Mechanics' Institute put on an exhibit up there, and someone set up a couple of stoves to take the chill off. I say "someone" with a note of contempt, because whoever the klutz was, he led one of the stovepipes over to the wall beside a chimney, banged a hole into what he presumed to be the flue and stuffed the end of the pipe into it. The stove apparently worked fine, and no one realized that the pipe had missed the flue completely and was pouring smoke and sparks into an air space beside it that rose upward to the rafters of the roof. The stove and its pipe were removed after the exhibit closed.

Winter of 1865 came on in the best Washington tradition—temperatures down to single digits. Rubbing his hands together to inspire circulation, Secretary Henry decided to get all the Institution's

DISPLAY CASES



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The Smithsonian fire was spectacular—but not this spectacular. Originally in *Harper's Weekly*, sketch depicts entire Castle engulfed in flames. In fact, only the central section burned.

ethnological specimens (their numbers were growing at a fast rate) into glass cases around the walls of that same upstairs exhibition room. Workmen set about taking down the pictures that ordinarily hung there, then moving the cases into place. William De Beust, staff machinist of the Institution, and carpenter T. N. Woltz fetched the nearest stove from what was called the apparatus room, and set it up, using, naturally, the existing hole for the pipe. Woltz later testified that he removed a piece of tin that had been tacked over the hole, reached into the opening "and found soot there, showing that it had been used before as a flue."

De Beust reported that a fire was kindled "with refuse stuff left by carpenters." The men then added coal. For more than a week the stove was lit every day, and, in Woltz's words, "drew first rate." The warmth made work possible. At quitting time each day, the fire was "suffered to go down." Staffers were fully aware of Dr. Henry's niggling fear of fire. He had cracked down on smoking in the Castle, had forbidden open lamps to be carried around and had seen to the provision of hoses and buckets.

On January 24, the task was nearly finished. De Beust shinned up into the loft above the lecture room because Woltz told him there were some pigeons up there. (I wouldn't be surprised if they're still there.) De Beust noted that

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there was no smell, even of coal gas. He walked back on the ceiling joists and clambered down to continue remounting the pictures above the display cases. At about 1 P.M. he went to the basement to help Woltz fix a sled.

Early that afternoon, probably around 2:30 (accounts vary a little on this point), Secretary Henry was busily writing in his office, along with the Smithsonian's chief clerk, William J. Rhees. Dr. Henry later reported in a letter that "we heard a singular noise above our heads and after listening a few moments I exclaimed 'the house is on fire!'"

Indeed it was. Having charred gradually for eight days, the false flue finally erupted in flames. They shot upward through the air space and very soon had the boards of the roof crackling merrily beneath the slate roofing tiles.

Dr. Henry ran downstairs to sound the alarm, but discovered that De Beust had beaten him to it. The fire engines *Hibernia* and *Meigs* arrived to find much of the roof a sheet of flames, which, according to an account in the *Philadelphia Inquirer*, "roared and hissed aided by a high wind." Apparently the two steam-powered pumpers could find no water handy along this part of the Mall, so for "over an hour" the fire had its way.

The *Inquirer* estimated that 10,000 people gathered to watch the blaze. "About three and a half o'clock," says the account, "the fire got into the wooden stairway of the main tower, and soon ran to the top, the flames shooting up through the top, making an enormous pillar of fire. The anometer [sic], or wind register on the top of the main tower, whirled away until about four and a half P.M., when it fell through to the bottom."

That crashed anemometer was only the beginning of the losses that the Institution suffered before the fire petered out—more, it seems, from lack of fodder than from the efforts of *Hibernia* and *Meigs*. Henry reported to Congress that, of the correspondence, some 85,000 pages went up in smoke. So did records of experiments, manuscripts for publication, reports and notes. Lost were the personal effects of James Smithson. The founder thus became even more of an enigma than he already was. Lost were about 200 portraits of the J. M. Stanley collection and many of the valuable and fascinating Indian portraits done by Charles Bird King. Lost was the library of a Beaufort, South Carolina, home that had been captured by Union soldiers. The books had been turned over to the Smithsonian for safekeeping.

Henry Horan, the night watchman, attested that he had chucked an armload of books out of the windows of the Secretary's office. Assistant Secretary Baird noted that "bookcases had been broken open and all the books . . . pitched out of the window." He got a policeman to put an end to that. Baird stated that two double-barreled guns were missing—probably pilfered, although a detachment of troops had been sent to the fire to prevent looting.

Staff members seem to have reacted to the emergency with nimble minds and stout hearts. Meteorologist W. Q. Force removed his most important papers until smoke drove him away. De Beust, with the help of Horan, saved a few portraits despite the crumbling ceiling of the exhibit room. De Beust also ordered a soldier to keep people out of the Regents' Room. Today, we proudly note that the Regents' chairs are

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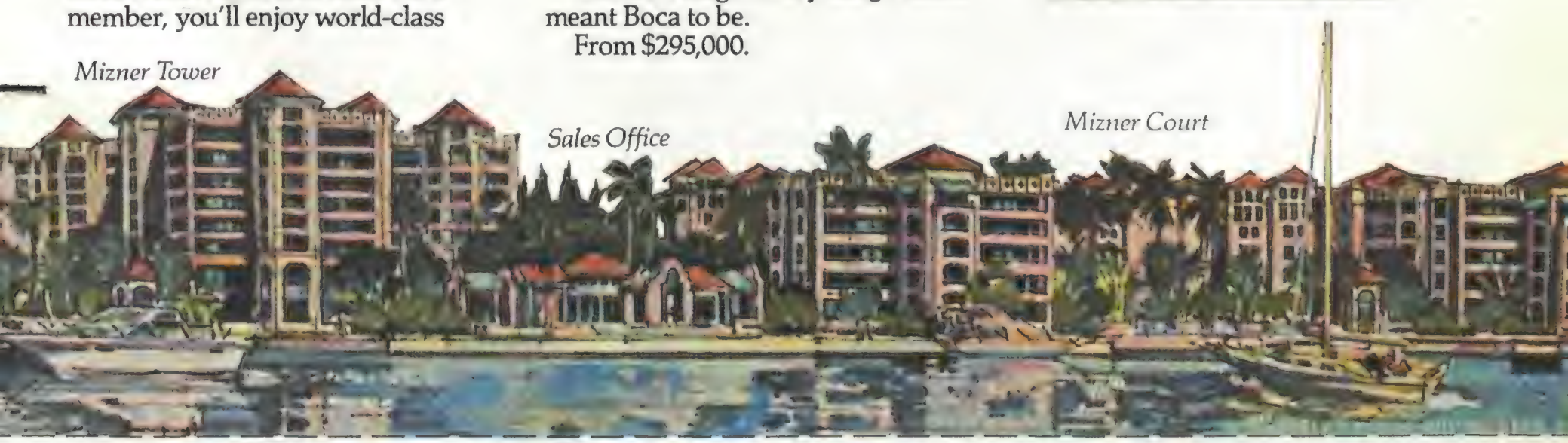

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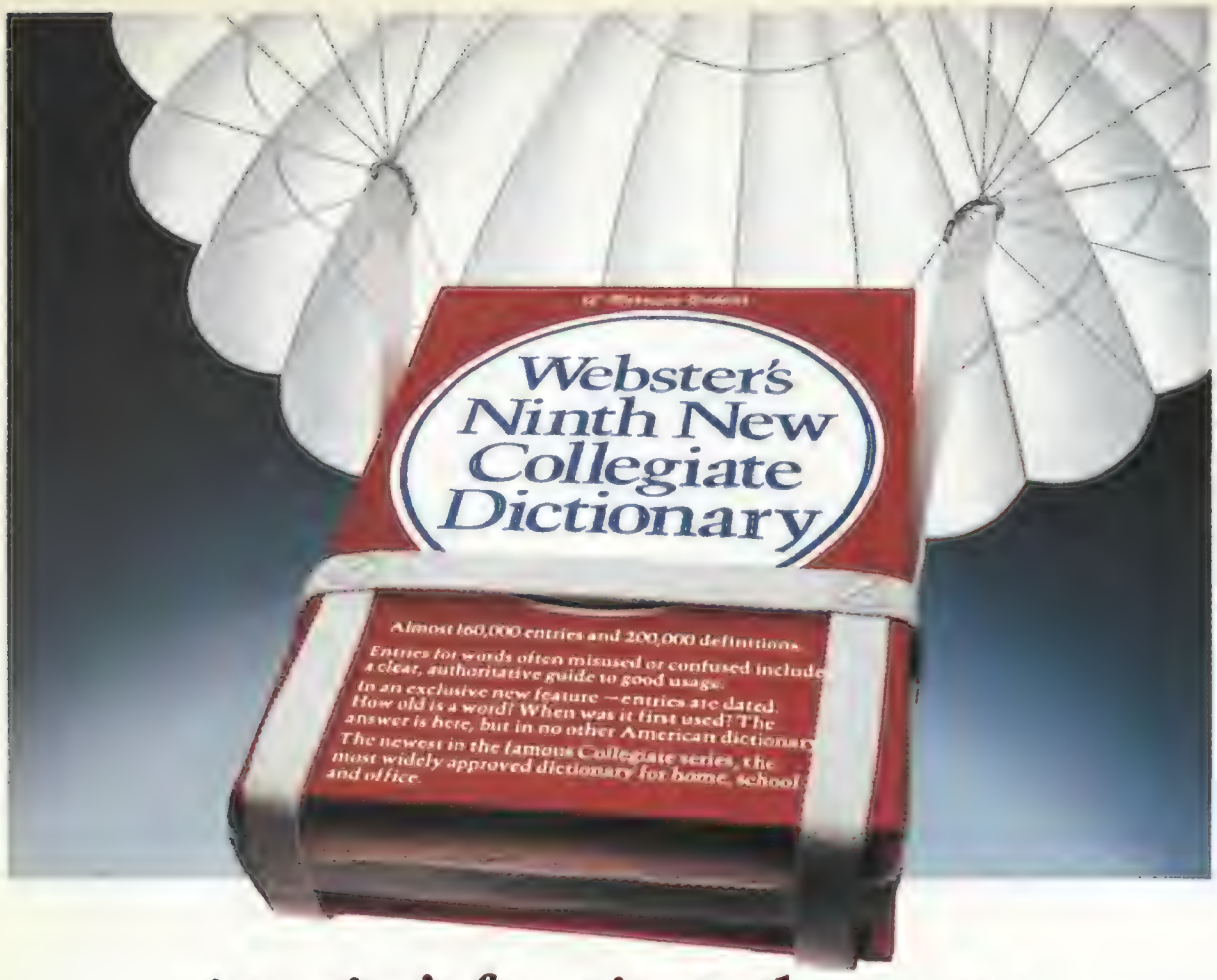
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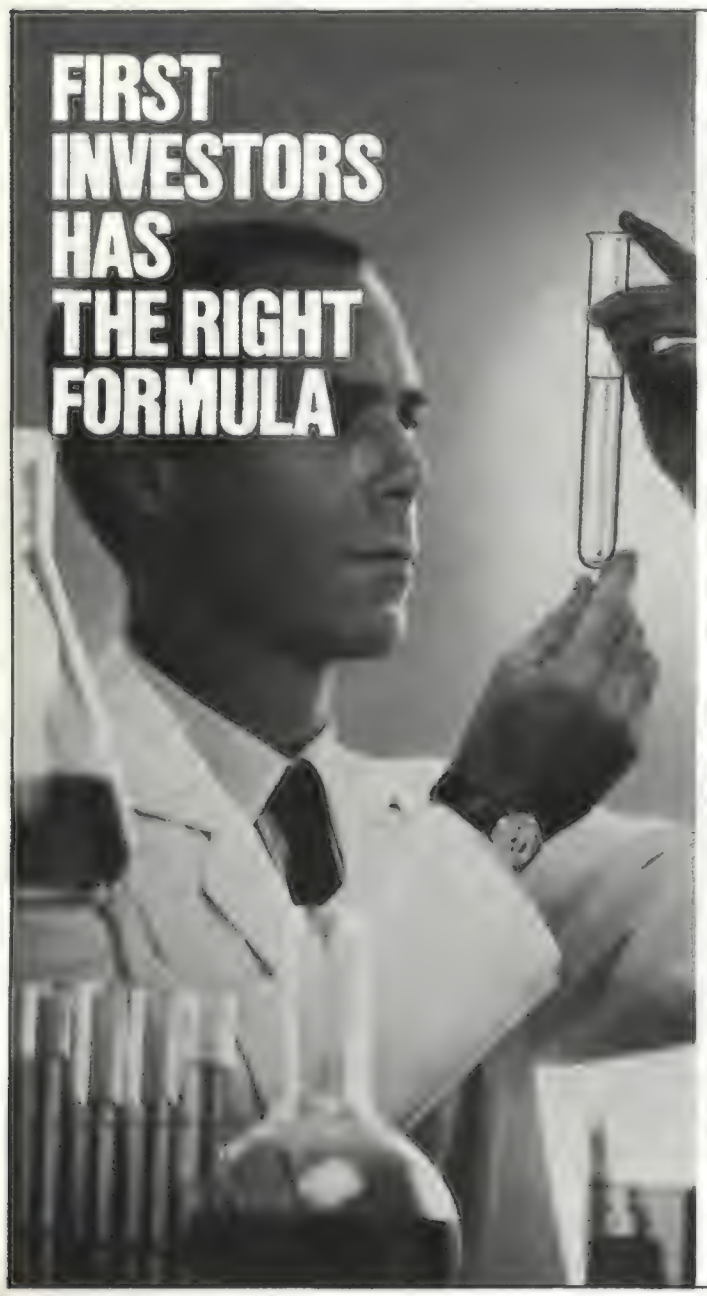

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the originals—survivors of the great fire.

Joseph Henry put in for a modest personal loss of $1,500 in the fire. De Beust totted up $1,300. The itemized list gives us an idea of the values of personal effects 123 years ago. His gravest loss, according to his own pen-written accounting, was his "Complete Set of Machenist tools of 20 years Collection," $500. He put his "Clotheing & Linen" at $250 and his 100-volume library of "old and rare work" at $200. A "Marble top dressing Bureau" that would probably have a modern antique dealer salivating was worth, he figured, $30.

The major structural losses to the Smithsonian were the roof of that central section of the Castle, the caps of a couple of towers, and the lecture hall, which simply collapsed. The collection of the Wilkes Expedition survived, as all who saw it on exhibit can attest (SMITHSONIAN, November 1985). So did Charles Willson Peale's full-length portrait of George Washington. As Henry's statement to Congress says, "The burning of the roof of the building can scarcely in itself be considered a calamity, since it probably would have occurred at some future time when a much larger accumulation of valuable articles might have been destroyed. . . ." Fireproof materials, which saved a good deal of the Castle, were used in the rebuilding that quickly started. New floors were added to the central section. Only in today's Wilson Scholars' library can the original floor partition be seen.

Henry never tried to get the lecture hall rebuilt. It was a big auditorium, seating some 2,000 people, and it had given trouble right from the start. Before and during the Civil War, the Secretary was torn between a sense of duty to would-be users and his determination to keep politics out of the Institution—for the Smithsonian lectures inevitably reflected the hot partisan feelings of the time. Abolitionists sounded off defiantly in this largely slave-holding city. President Lincoln himself was inveigled into appearing at one of these violent discussions and was, it is said, embarrassed by confrontations afterward.

Henry writhed at this usage of the Institution. When the fire was over, a new lecture hall was not on the agenda. But, we are happy to note, among the improvements that the Secretary sought was "a thorough heating of the whole building by steam or hot water."

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Phenomena, comment and notes

The Northern Hemisphere is going cold and dark as the planet whirls silently toward the winter solstice, when the sun touches its lowest point in our sky. For most of us in temperate zones, the cold is uncomfortable and inconvenient, a time of struggling into overcoats and scraping ice off the windshield. But for a passionate subset of the population, a dropping thermometer means rising spirits. These are the people who come out their front doors to be slapped by an icy wind and break into broad grins, exulting to themselves: "The pond is freezing!" At night they rummage through the cellar for skates and for wooden sticks with curved blades shaped like the forceps that obstetricians use in difficult deliveries.

The human mind is not only very good at adapting to difficult circumstances (the cultural explosion we are still giddily riding apparently began during the last Ice Age) but at finding ways to have fun. A patch of ice in one's path is an obstacle to be negotiated carefully—unless one is a child, in which case the obvious solution is to run full tilt at the ice and then slide across it. At least 2,000 years ago an adult thought to strap pieces of elk rib to the bottoms of his feet so he could glide across ice. We have no written records of the event, but surely as this inventive ancestor gained some proficiency, he (she?) began to sweep around in great arcs for the sheer exhilaration of it. There must have been a sudden rush on elk ribs.

Metal skates appeared and by the Middle Ages—especially in places like the Netherlands—ice skating was an established human activity. Like all the best "machines," skates multiply human abilities. A sedentary over-50 who wouldn't dream of running a hundred feet can skate for miles. The underlying physics has to do with reduced friction—the same principle allows sleds to go like the wind (see page 138).

Ice hockey did not develop as a game until the latter half of the past century, according to the *Encyclopaedia Britannica*, when British soldiers stationed in Canada adapted a stick-and-ball game to the frozen ponds that confronted them most of the winter. (The story that the legendary Gordie Howe learned the game scrimmaging with Indians on the Detroit River, using a frozen elk liver as a puck, is, sadly, not true.)

Today professional hockey is a big-time sport. That game is violent and sometimes brutal, with teams hiring some players for their fighting—rather than their hockey—prowess. But a gentler game is played on frozen ponds, lakes and rivers across the northern half of North America. One of the most de-

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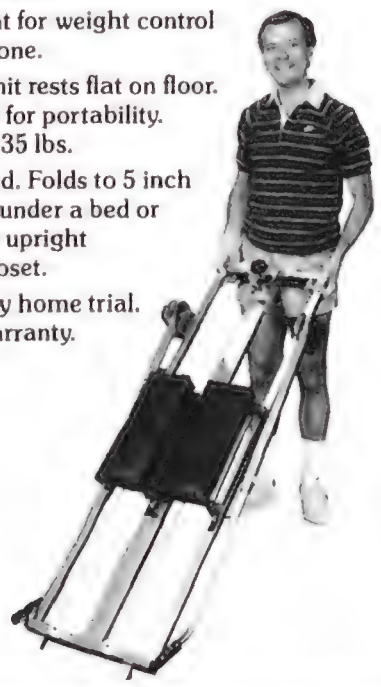

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lightful weather reports I ever read, "Snow, followed by small boys on sleds," could be modified to "Cold, followed by males wobbling on skates."

I learned to play at a small high school in western Massachusetts (I was one of the players put in the game for the final minute when our team was ahead or behind by three goals). We played in a swamp. In the fall we would open the dam and when the water level dropped we would wade into the muck to scythe away that year's vegetation. Then the dam was closed, the water rose and, when the weather was cold enough, we had ice. The boards—the wooden "fence" that enclosed the rink—were bolted together and we were ready. Every time it snowed we had to shovel; by the end of the winter the snow outside the rink was much higher than the boards and the few brave spectators stood high above us. When the ice got too rough we would chop a hole outside the rink and use a little pump to spray water and make a new surface.

As a "young adult" I played for a while in friendly games on Tomahawk Lake in the Hudson Valley, but basically put the game behind me as something for the young. Decades later in Maryland, to my surprise and delight, the heirs to my fortune took up the game on their own at the local pond, learning to skate as they learned to play. I stayed away, knowing I was too old. Then came the year when my oldest could no longer wait for the pond to freeze and started buying time on a rink in Baltimore. He and his friends needed bodies with $10 bills, and he craftily bought for me a Koho All-Star stick made in Finland. For a man who by any reasonable standard cannot skate, cannot stickhandle the puck and cannot shoot, I'm having a wonderful time.

(There are embarrassing moments. Once a friend came to watch. During a lull, I skated over to ask her how she liked it. She had been afraid, she said. Because it's such a fast, rough game? I asked, visibly puffing up. Oh no, she replied, I thought you were going to have a heart attack.)

Hockey gives skating a purpose, an immediate, all-encompassing purpose that leaves no time to think consciously about the skating itself, with the result that you end up skating much better than you thought you could. The sudden dashes, quick turns, ice-shaving stops that are routine in a game are em-

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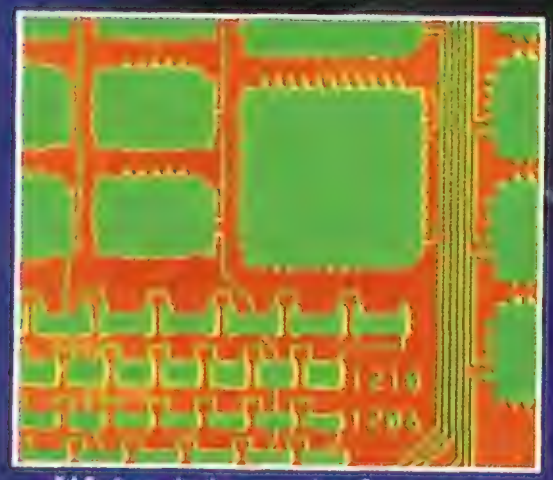

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bellishments you would never essay while taking sedate turns around a pond or public rink. Self-consciousness is gone: there is no time to think about form or what you may look like, not even time to fear a hip-bruising fall. Play breaks off, you straighten up and relax—and still you are in a fast gliding turn behind the net, feeling you can still skate after all.

Our games are friendly. There is no checking (running into opposing players). Some of the regulars are very good skaters, others fall down when they take a swing at the puck. Some are in full pads, others in street clothes. Fans of the professional game may sneer that we know we are not going to get a deliberate elbow in the teeth. But there's more to the game than street brawling. A standing joke among fans goes along the lines of, "We were watching the fights when a hockey game broke out." The same thing happens with us, from a different direction. We can be milling around, flailing aimlessly at the puck, making passes to nowhere, when real hockey breaks out. A player who a moment ago was defending in his own zone will break away with the puck, angling across the rink as he and his mates dash up the ice, stickhandling past defenders; then quick passes crack off sticks like pistol shots until an opponent is pulled out of position and a rising shot sails into the net. High-fives all around, to a derogatory chorus from the other side. And then it starts all over again.

Hockey games are apt to break out any place that water freezes; skates and a wooden stick are all a player really needs.

Someone shoots the puck into the corner, and you and a defender rush after it. Nobody is going to hammer anybody into the boards, so you concentrate on the matter at hand, getting your stick under the other guy's, tapping the puck just out of his reach for a split second, trying to find an open man to pass it to. Or four or five players jam up

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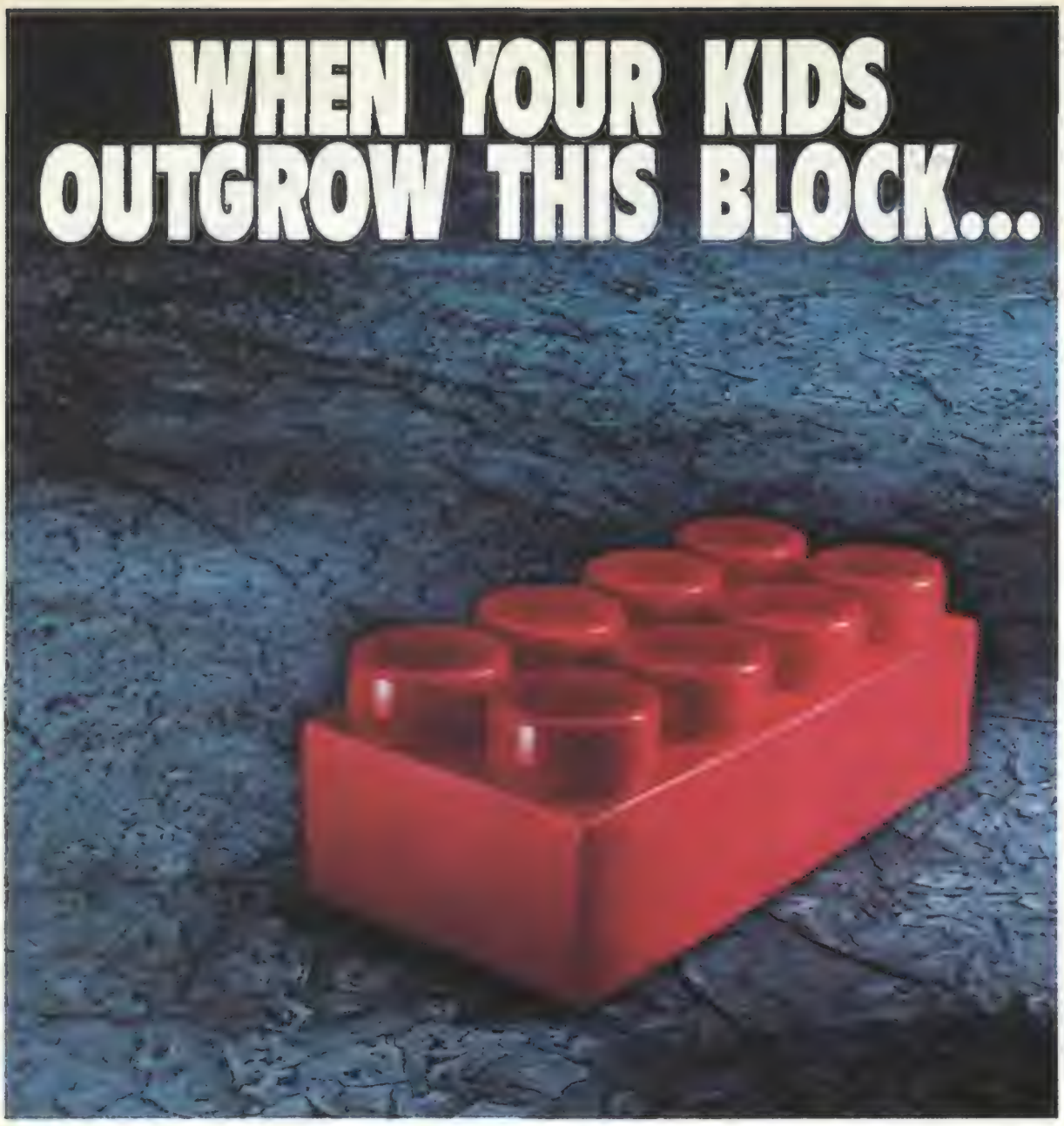

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in front of the net, flailing away at the puck like woodchoppers. Bodies push bodies, some discreet hooking and holding transpire, but nobody's going to flatten anyone, and as the puck comes to rest for a split second, a heightened alertness lets you flip it into the net.

Pickup players can sneer at the pros in one respect. Instead of playing at top speed for two minutes and then being replaced by fresh players, the gentle cousins tend to play the whole game, often with fewer than the regulation six to a side. As the game progresses, bursts of intensity are followed by unofficial time-outs while players flop to the ice to catch their breath. A player who falls in the heat of battle lies there a few seconds—not hurt, just resting. A breakaway is sometimes a solitary dash: teammates and defenders alike are too tired to follow. The game becomes as much a contest with complaining muscles as with opposing skaters.

Injuries are rare. In three years now I've been hurt only once, when another player and I ran into each other at full speed. We both saw it coming and started dodging to one side and then to the other, trying to miss each other like two strangers on a sidewalk, only to collide. I punched his shoulder with my face. My only regret is that the doctor took such tiny, neat stitches that I have no visible badge of honor.

The pond water is frigid now; each new cold front carries the promise of ice. Ice carries the promise of hockey, a time of dispensation from our physical limits. For an hour we can move unnaturally fast, and even—now and then—with a grace foreign to our everyday lives. We know ineptness, when we lose the puck off our own stick or stumble and fall at a crucial juncture. But we also know the other times: a loose puck, a dash down the sideline with no thought for burning quadriceps, the curving in toward the goal as an opponent comes out to cut down the angle, a shot from the side at the last second before flying past the goal, the puck in the net. Mock astonishment on a son's face. The long, sweet glide back to your own zone.

I hate coming out of work to find it is night. I don't like a winter wind cutting my face. But the cold that hurts my face also causes water molecules to link together in a rigid lattice—and middle-aged men to fly. The pond is freezing.
John P. Wiley jr.

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QUEBEC

COMBINED AMERICAN FORCES ATTACK QUEBEC DEC. 31, 1775

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CHAUDIÈRE R.

CANADA

MONTREAL

ST. JOHNS

DEAD R.

KENNEBEC R.

MONTGOMERY'S ROUTE

MAINE

NEW YORK

FORT TICONDEROGA

MONTGOMERY STARTS FROM FORT TICONDEROGA AUG. 28, 1775

NEW HAMPSHIRE

ARNOLD'S ROUTE

ARNOLD LEAVES FROM NEWBURYPORT SEPT. 19, 1775

NEWBURYPORT

SIEGE OF QUEBEC

MASSACHUSETTS

By Edwards Park

Could Canada have ever been our Fourteenth Colony?

Well, probably not. But in 1775 an astonishing two-pronged assault, one heroically led by Benedict Arnold, nearly took fortress Quebec

For a moment I thought I would die, right there on the Plains of Abraham, outside the walls of Quebec. Bitter gusts whirled up the St. Lawrence, and the path vanished behind a curtain of driving snow. I lunged forward against the wind, eyes half closed by ice from my frozen breath, lost my bearings and abruptly was hip deep in a drift.

That was the moment. I felt too tired to struggle. Too old. Too cold. The game wasn't worth the candle. The hell with it, anyway. Then the irony of the situation struck me, and instead of slipping into that pleasant drowsiness that precedes freezing to death, according to Jack London, I found my icy face cracking into a smile. Here I was reliving a fraction of what Arnold's men had gone through, and collapsing helplessly in the process. What in the world would they think of me, succumbing like this with a hot breakfast inside me and a sybaritic hotel room only a mile away?

Those men whom Benedict Arnold led to Quebec in 1775 reached this same spot after one of the most remarkable feats in American history. For six weeks they had battled through trackless forest, thundering rapids and ice-rimmed marshes some 250 miles from the last settlements along Maine's Kennebec River to the citadel of Quebec. Starving, freezing, lacking proper equipment, they had reached this same spot by calling on reserves of toughness and stubborn courage likely to put anyone to shame. And on the last day of 1775, that tiny army of ragged soldiers came within an inch or two of taking North America's most formidable city and perhaps making all of Canada a Fourteenth American Colony.

In the spring of 1775, after the first battles of the American Revolution, the acquisition of Canada wasn't as wild an idea as it seems today, and if it could be done at all the key was Quebec. Most Canadians were French. Britain had conquered them only 16 years before in an epochal battle on these same Plains of Abraham during the French and Indian War. Surely, thought many of the rebellious Colonists, the Quebecois must see the rebellion of the southern Colonies as a God-given chance to be rid of their British masters.

There were monumental difficulties, of course: the strength of the fortress of Quebec; and Britain's farsighted Quebec Act of 1774, which granted French-speaking citizens of the province extraordinary rights and advantages. But it seemed worth a try. The Second Continental Congress, at least, thought the French Canadian *habitants* might answer destiny's nod. On June 27, it agreed to a military movement north, but only if it "will not be disagreeable to the Canadians. . . . "

George Washington, newly appointed Commander in Chief of the Revolutionary forces, had no sooner arrived at his Cambridge, Massachusetts, headquarters than a stocky Connecticut ship captain burst upon him, begging permission to invade Canada. Washington paid full attention. For this vigorous, athletic officer had proved himself by helping capture Fort Ticonderoga on Lake Champlain, and then taking control of the lake's shipping to discourage the British from using it as an easy way to attack the Colonies. Arnold, his name was. Benedict Arnold.

Washington agreed with Arnold that seizing Quebec and keeping control of Champlain would foil any British plans to invade from the north. Waterways were the only routes that an army could follow

Map (with some modern boundaries for orientation) shows the routes of the attack, one up the Kennebec, one up Lake Champlain and down the St. Lawrence.

Illustrations by Arthur Shilstone

Hauling and shoving heavy, leaky boats against the rush of the Kennebec's sporadic rapids, Arnold's men struggle northward through province of Maine.

through the wilderness. On September 14, he penned approval of Arnold's plan of attack, adding the charge "that you consider yourselves as marching not through the country of an enemy, but of our friends and brethren . . . and that you check, by every motive of duty and fear of punishment, every attempt to plunder or insult the inhabitants of Canada."

The plan called for a lightning stroke at Quebec from the most unlikely quarter. With some 1,100 picked troops, Arnold was to move up the valley of Maine's Kennebec River, cross the Height of Land to the St. Lawrence River basin, then slip down along the boiling waters of the Chaudière River to a point on the St. Lawrence directly opposite the old walled city. Crossing over, the little army would meet up with a similar group, which, advancing northward via Lake Champlain and the Richelieu River, would have by then seized Montreal and moved north. The combined force would overwhelm Quebec.

The expedition started auspiciously. Washington wanted Arnold to take along some Pennsylvania and Virginia riflemen, partly because they had a reputation as the best fighters in America and partly to get them out of Cambridge where they were said to be stealing everyone else blind. Two companies of Pennsylvanians were chosen and one of Virginians, under a French and Indian War veteran, Daniel Morgan.

The rest were two groups, roughly called battalions,

Edwards Park has often written about the American Revolution in SMITHSONIAN, *including a memorable cover story on the Battle of Yorktown (October 1981).*

of New England volunteers. Most were under 30, many in their teens. They had been reared on tales of the French wars, of scalping raids on their frontier villages. The very thought of the old citadel made their Yankee scalps prickle. They had been taught to revere James Wolfe, the British general who died as his redcoats defeated the French under Montcalm in 1759, ending the terror.

All the troops doted on Colonel Arnold. Feisty, arrogant, hyperactive, always resourceful, he cared deeply for his men and he wanted to fight. He equipped them well with tons of supplies: clothing, plenty of ammunition but no cannon, food enough for 45 days —twice what everyone thought they'd need. Surely in only three weeks they'd storm into Quebec, to feast on captured viands and French wine.

Women came to cheer them on

In bright September weather they marched from Cambridge to Newburyport, and young women in the village came to their picket fences to cheer them on. From there they boarded small coastal vessels and sailed for the Kennebec. At the Colburn and Agry boatyards in Pittston, Maine, they debarked and loaded supplies into 200 bateaux, double-ended, overgrown dories hurriedly banged together by local carpenters out of the only lumber available, unfortunately green and heavy. The boats weighed about 400 pounds apiece and leaked steadily. Some troops prepared to row and pole them upstream; each held six or seven men. Others tightened their boots and moccasins and set off along the riverbank.

They paused at Fort Western, now Augusta, the state capital, where a small frontier settlement offered decent food and even a few roofs to sleep under. Today, the actual fort, including two rebuilt blockhouses and the original storehouse-barracks, is a museum.

Here Arnold organized his expedition. First, a small reconnaissance party paddled off northward, moving fast in a couple of light, birch-bark canoes. Then the riflers set out, with Dan Morgan bellowing them on like a teamster. The Virginians, generally tall and mostly wearing gray cotton hunting smocks, were put in the vanguard to clear the way for (and be unable to steal from) the rest of the army. After them went the two Pennsylvania companies, similar types, lugging their skinny, deadly, long-barreled rifles.

The battalion led by Christopher Greene of Rhode Island and Timothy Bigelow of Massachusetts pushed off next. Bigelow was a blacksmith, Greene a kinsman of Nathanael Greene, who was to become Washington's most trusted general. Traveling with this group as a volunteer officer was the cocky 19-year-old grandson of Jonathan Edwards. The grandfather may have frightened all New England with his Calvinistic sermons 30 years before, but throughout the terrible journey to Quebec the grandson, Aaron Burr, apparently managed to dally with a young Indian woman known to the troops as the "Abenaki Queen with golden thighs."

The second battalion was led by two Connecticut officers: the oldster of the army, 42-year-old Roger Enos, and Return Jonathan Meigs, whose name evidently originated when his grandfather, riding dejectedly away after being rebuffed by a sweetheart, heard her suddenly call after him, "Return Jonathan!" Exuberantly, he named his son after his bride's relenting words, and to this day the name has stayed in the family. This battalion was to tote and safeguard the bulk of the supplies. A wearying chore, but it would follow a roadway of sorts, already cleared and trampled through the wilderness.

Scarlet and gold maples, bright against dark evergreens, greeted the young soldiers. The air was sweet and dry, the days clear, the nights cool and sparkling. The army churned its way upstream with oars and poles, the boatmen whooping back and forth. Pvt. Abner Stocking of Connecticut, one of many soldiers who kept a journal of the great adventure, noted that they made about seven miles, camped at the edge of a cornfield and "fared very sumptuously."

Enduring appalling hardship, including starvation, troops eat leather shot pouches, soap, even candles.

Arnold's famous march to Quebec

Seven miles doesn't sound like much, but the Kennebec here is less serene than it seems. At its rapids, bateau crews would pole vigorously and hop out to tow, stumbling in their moccasins through rocky shallows. Often they had to beach the boats and unload them. Four men would then carry each craft around falls or rapids, staggering uphill over rocks and through underbrush, each man shouldering about 100 pounds. After the exhausting portage, back they would go to help lug the supplies.

North of the small settlement of Vassalborough, big trouble awaited. Ticonic Falls, where Waterville now sprawls, took a while to get around, and then Five Mile Ripples tested everyone's mettle. Fast water tore at the bateaux and at the men who plunged into the stream to keep the bows headed into the current. Boats broke loose, bashing against the rocks. Now the folly of hastily made bateaux became apparent. The wood had never cured and so couldn't swell in the river and close the seams. Water kept coming in, seeped into barrels of bread, dried cod, dried peas, swelling the contents. The staves burst apart and the boats sloshed with a noxious soup of useless supplies.

Today, at the old mill town of Skowhegan, a little park high above the river displays local history on a signboard: the name means "Watching Place"; William Bradford and some Boston associates bought the land from the sachem of the Kennebec in 1648 for four hogsheads of bread, peas, cloth coats, "strong water" and other essentials. Margaret Chase Smith was born here. Oh, yes—it says Arnold camped on the island that now holds the town's center.

That island has a steep rock face. Somehow, incredibly, the men hoisted their half-wrecked vessels up it, and their soggy supplies and themselves, battered and bloodied, to camp above Skowhegan Falls. Seeing his schedule falling apart along with his miserable bateaux, Arnold exhorted his weary soldiers on, on, on.

"We found the water more still," wrote Private Stocking, on September 30. "We proceeded 5 miles and at sundown encamped in a most delightful wood." But next day more rapids roared at them. Into the icy water they jumped and, Stocking continues, "While one took the batteau by the bow, another kept hold of the stern to keep her from upsetting or filling with water. Thus our fatigues seemed daily to encrease. But what we most dreaded was the frost and cold from which we began to suffer considerably."

Passing here today, in October, the river seems merely beautiful. But a solid cloud, a stratus, darkens the foliage and hints of snow. It breaks in the west at sunset, and feeble light sweeps under it. And the open sky has the crystal clarity of the cold northland. You're glad of your motel room that night. And you can't imagine anyone camping out, soaking wet.

At Norridgewock Falls, Arnold ordered a halt to repair boats and men. Cold rain drenched the en-

November 9, 1775: Arnold's ragged forces reach Levis, opposite Quebec on the ice-rimmed banks of the St. Lawrence, getting a brief glimpse of the city they will finally try to take on New Year's Eve.

campment and illness crept through the ranks—dysentery, "camp fever," a great storm of coughing in the night. Arnold chivied the men to hurry, to get back on the river and, miserable in the rain, they set out again "through a trackless wilderness."

Today Route 201A clings to the Kennebec and links pleasant little towns—Madison, Anson, North Anson, Embden, Solon—where many houses boast rich views of nearby mountains. Thanks to a huge dam at the town of Moscow (pop. 572), the river has changed so much that accounts of Arnold's march make little sense. But a roadside sign on the east bank notes that across the stream was the beginning of the Great Carrying Place where the men left the Kennebec and struck out westward to pick up the Dead River and follow it over the Height of Land—a wild, lofty divide that now marks the Canadian border.

The Dead River, which is the west branch of the Kennebec, meets the main stream at The Forks. Here the Kennebec is young and lively, and the Dead enters it with a strange stillness that perhaps explains its name. Indians, and later a few trappers and mappers, carried their canoes about two and a half miles from near the present village of Caratunk to East Carry Pond. They paddled across, made a shorter portage to Middle Carry Pond and from there slogged another couple of miles to West Carry Pond. That put them close to the Dead River.

Canoeists in this high country still face a bewildering maze of streams and mountain marshes, so it's little wonder Arnold's army strayed, got lost, got mired in icy bogs where men sometimes plunged over their heads, then tore their moccasins on the broken branches of deep-sunk trees. To add to their misery, a great storm—the tail of an autumnal hurricane, beating itself out in northern New England the way they still do—flooded the river, clogged the shore with fallen trees and spoiled the fishing. The Dead River's bountiful trout had been keeping the troops alive.

By now most supplies were ruined and game was

Clad in captured British blanket-coats and carrying ladders, they plunge to attack in a snowstorm.

very scarce. (Ironically, a "Moose Crossing" highway sign appears just where hunters were dispatched, with no luck.) Dr. Isaac Senter, volunteer physician for the army, tells of "Col. Greene's division, etc., waiting for the remainder of the army to come up, that they might get some provisions, ere they advanced any further. Upon inquiry I found them almost destitute of any eatable whatever, except a few *candles*, which were used for supper, and breakfast the next morning, by boiling them in water gruel, etc."

A message went back to the last division with the reserve supplies. Would Colonel Enos kindly hurry them forward to save lives? Reluctantly, Enos parted with two and a half barrels of flour. *Two and a half barrels* to feed some 700 sick and starving men! He then discussed the situation with his subordinates and with little trouble they persuaded him to give up the game. He took off southward with about 300 men. Arnold, far in the vanguard where he was desperately trying to reach the French *habitants* and line up food for his troops, could do nothing to hold Enos. If there was a traitor in this devoted little army it certainly wasn't Benedict Arnold.

The measly dollop of Enos' flour didn't go far. On the line of march, a rifleman named George Morison noted "I roasted my shot pouch and eat it." And weeping, Capt. Henry Dearborn of New Hampshire lost his beloved black dog to the cause. It was cooked and "instantly devoured, without leaving any vestige." Dr. Senter wrote on October 7, "Our bill of fare for last night and this morning consisted of the jawbone of a swine destitute of any covering." The men ate "shaving soap, pomatum, and even the lip salve, leather of their shoes, cartridge boxes, etc."

For a dead soldier, a blanket of leaves and twigs

The tale is told of Jemima Warner, one of three women who trekked alongside their men through all the horrors. Circling a bog, she realized her husband had vanished. Backtracking, she found him barely alive, stayed beside him until he died, scratched some leaves and twigs off the frozen ground to cover him, then caught up and staggered on toward Quebec.

The survivors reached Lake Megantic, now a beautiful sight in the broad vistas of southern Quebec Province. The low autumnal sunlight paints meadows a special, almost Irish, green against dark firs and spruces. It was wooded and wild in '75, and Arnold's people were too hungry and too busy with the roaring rapids of the Chaudière (at least now roaring in the right direction!) to notice beauty. But they did notice, nearing the settlement of Sartigan, what Dr. Senter called "a vision of horned cattle" approaching from the north. It was not a mirage. Arnold had reached

Spring 1776: relieving units of the British Navy push their way through the river ice off Quebec's Lower City, and what is left of the siege has to be broken off.

the first farms, bought the beefs and hired *habitants* to drive them back to the gaunt scarecrows, bleeding, starving, clad in shreds of clothing, that were his troops. "Each man was restricted to one pound of beef," says Senter. Even so, one man died of overeating.

On November 9, Benedict Arnold and some 700 survivors crouched on the banks of the St. Lawrence where the present town of Levis now perches, and gazed across the river at the distant steeples of Quebec, high on its escarpment. Canoes were rounded up, scaling ladders built, and on the night of the 13th the force slipped across the broad river, under the very gunwales of two British warships lying at anchor.

They made for the same landing place that General Wolfe used on his attack in 1759: Wolfe's Cove. It's a steep cut in the northern bank of the river, and when you struggle up a narrow, twisting trail from it, you're on the Plains of Abraham, where Wolfe fought Montcalm and both generals took mortal wounds. Here Arnold assembled his men. They had made their landing in secrecy, but before the scaling ladders could be brought over, a British patrol boat investigated and the riflemen fired on it. Had the ladders arrived that night, the desperate, half-frozen men might have stormed the city, then defended only by a temporarily weakened British garrison. Very possibly, the Americans would have taken Quebec.

Frustrated, the soldiers waited for the second arm of the pincer movement—Gen. Richard Montgomery and his men who had followed the much-used route up Lake Champlain and down the Richelieu to attack, and successfully capture, the village of Montreal.

Montgomery, Irish-born, had served under Gen. Jeffery Amherst in the French and Indian War, then sold his British commission in 1772, bought a New York farm and married into the powerful Livingston family. Fortunately for the American cause, this splendid soldier offered his services in '75. Now he hastened to Arnold's aid with captured British uniforms, including white blanket-coats and fur caps that could be pulled down over the ears. At last the army was warm. And with Montgomery's 300-odd troops—Arnold's veterans thought the New Yorkers a miserable lot—the total number was up to about a thousand.

The trouble was, the end of the year was approaching and enlistments were running out for the militia. Montgomery and Arnold knew they must attack before New Year's Day 1776. They also knew, now their secret was out, that they needed a snowstorm to cover the assault. The days of December passed, bright and pleasant. For once, Arnold and his officers prayed for the bad weather they'd so dreaded on the Kennebec. Where was the Canadian winter, now that they desperately needed it? It came with a rush in the early morning of December 31—blinding snow, lashed by a cold northeaster.

In the black, bitter early morning of that day, December 31, I tracked Arnold's route, from the St. Charles shore to the Rue Sault au Matelot, a narrow lane lined with ancient stone buildings. The snow whirled into it, squeaked under my boots and dimmed the light of streetlamps. To my right a great stone cliff

loomed upward to end in the walls of the Upper Town. Here, in 1775, Arnold led his men, quietly urging them on with their scaling ladders and pikes. Then distant cannon thudded. Montgomery's column was striking the western side of the Lower Town. At that the bells of the Upper Town clanged, the sound muffled by snow, and a galling fire poured down on the Colonials as they rushed a wooden barricade blocking the street.

The musketry was ill aimed in the dark, but a few men dropped. A ricocheting ball caught Benedict Arnold in the leg. He collapsed, his blood staining the snow, then propped himself up and shouted: "Don't give up! Go on boys! Go on boys!" Dan Morgan seized command, sprang at the barricade and then fell back. Hit, yes. Stopped, no. He leapt at the barricade again, this time with his riflemen around him. They took aim at fleeing figures, but could only click the hammers. The locks were wet. Never mind. Moving fast and using pikes, they overran a second barrier and took more prisoners than they could handle.

Ahead of them was Mountain Street, and as I followed their footsteps, two centuries later, I found it ahead of me, too, Côte de la Montagne, steep, winding up to a beautifully restored gate in the wall. And beyond that stood, and still stands, the old seminary, the Basilica of Notre Dame, all the ancient landmarks of the Upper Town. I could climb the street now, and in no time be drinking hot coffee in Quebec's most famous hotel, the Château Frontenac.

Not so the young ghosts from the past that haunted me that early morning. They cleared defenders from the houses that overlooked them (many still stand) and then waited for Montgomery. He never came. He had assaulted a barricade at what is now heavily traveled Boulevard Champlain. One story has it that the defenders, befuddled by New Year's celebrating, fled. Then one, a British naval gunner, turned back long enough to lay a linstock on the touchhole of a cannon crammed with grape. It instantly killed Montgomery and two of his officers. The rest ran. As the sky lightened, a detachment of the British garrison stormed in on the rear of Arnold's men and captured them. A few escaped by hopping across two miles of shifting ice at the mouth of the St. Charles River.

Arnold had to be carried from the street where he fell and ended up in an American field hospital a mile away. His wound healed and he wrote his wife that he was waiting for reinforcements: "I have no thoughts of leaving this proud town until I first enter it in triumph." But as so often happened in Arnold's career, a series of officers took over from him who had no such thoughts of a fresh attack.

"Huge, coarse cheers, exuberant, defiant, rocked the cold air. Cheers for their indomitable leader. Cheers for the battle to come. Cheers, surely, for hardship endured, for an incredible battle already won."

So ended the attempt at Quebec, thanks to a blind ricochet and a drunken cannoneer. Less than two years later in the fall of 1777, Benedict Arnold's dashing heroism at Saratoga brought the victory that persuaded France to enter the war. After that glory, he gradually slipped away on his dark path to treason. Even today, stories of his unquestioned courage and tactical genius and outstanding leadership are strangely embarrassing to us.

Colonel Enos was court-martialed for "quitting without leave." The court acquitted him and he settled in the New Hampshire Grants, which became Vermont. My road map shows a town called Enosburg Falls, not far from the Canadian border.

Henry Dearborn, mourning his dog, was taken prisoner at Quebec, was paroled, and fought heroically throughout the rest of the war. Perhaps he lived too long. Called back in the War of 1812, he was dismissed for incompetence.

However close the Americans came to seizing their Fourteenth Colony, in retrospect it's clear they couldn't have held it. For the Quebec Act had healed most of the wounds of the French and Indian War. It also appeased Gallic sensibilities by extending Canadian boundaries to the Ohio River—right across the claims of Massachusetts, Connecticut and Virginia—and guaranteeing the Roman Catholic *habitants* the right to practice their religion.

So the extraordinary march to Quebec fades, a mere mention in history. One moment in the story will never fade from my mind, though. It occurred weeks before the battle, in November, when Arnold first got his men across the St. Lawrence and up on the Plains of Abraham. Next day he paraded them in front of the walled city, just beyond musket shot. It was a standard tactic to express an army's readiness to fight.

Instead, the redcoats and the Quebecois watched these wild survivors of the wilderness form a single line about 300 yards wide. They saw the colonel move out in front of the troops and raise both arms. And at that his men *cheered*. Many hatless, scabs on their knees showing through their rent breeches, boots often of raw cowhide stuffed with straw, they cheered again and again, great shouts that echoed off the fortress city. The people listened to these ragamuffin figures and found it hard to laugh. For indeed they had wrought a sort of miracle, back there in the forests and marshes.

The huge, coarse cheers, exuberant, defiant, rocked the cold air. Cheers for their indomitable leader. Cheers for the battle to come. Cheers, surely, for hardship endured, for an incredible battle already won.

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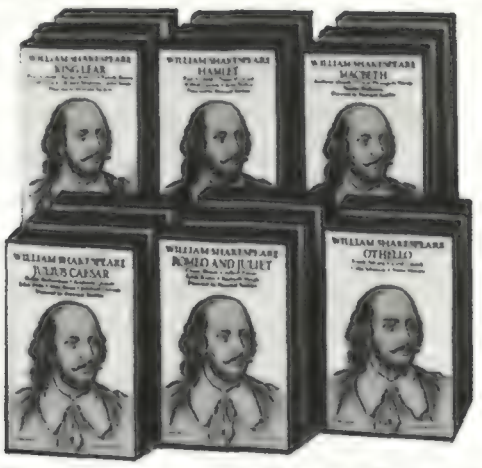

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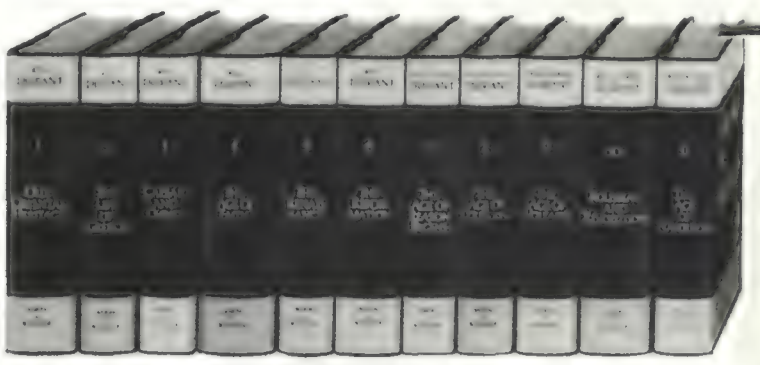

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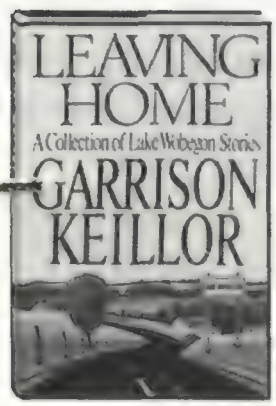

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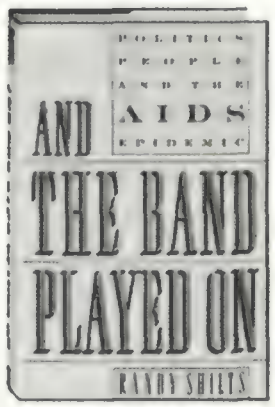

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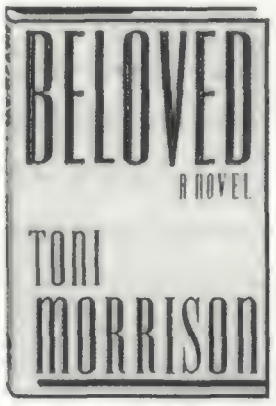

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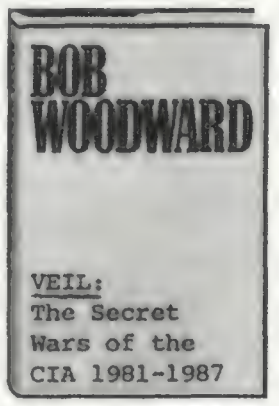

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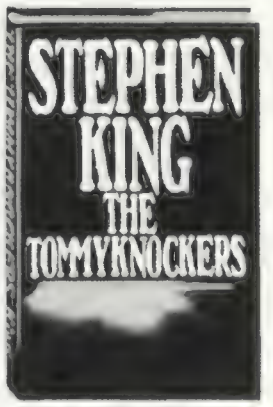

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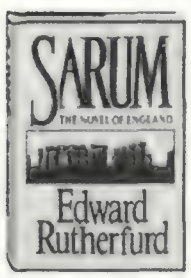

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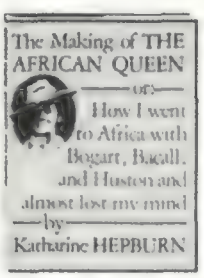
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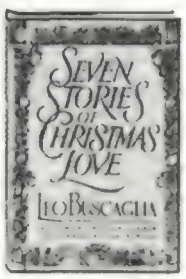

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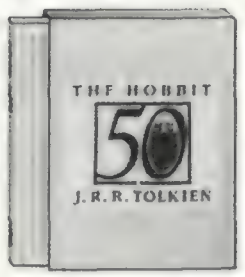

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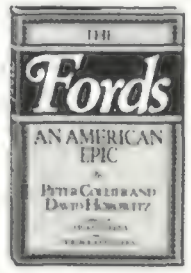

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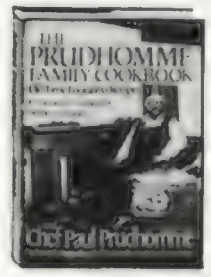

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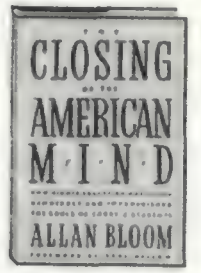

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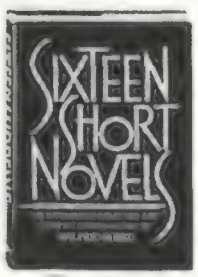

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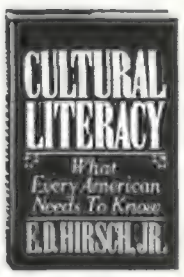

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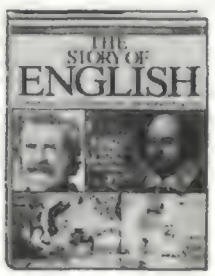

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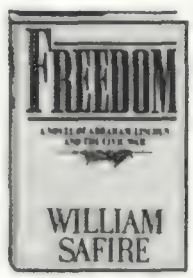

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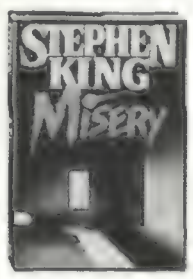

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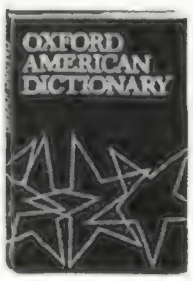

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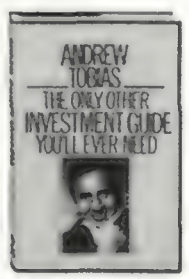

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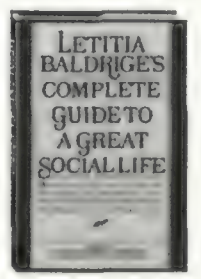

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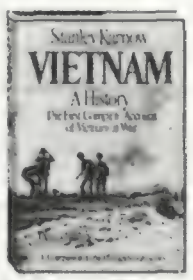

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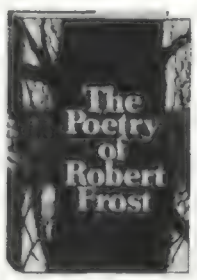

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By Daniel Cohen

Charles Tiffany's 'fancy goods' shop and how it grew

Starting small in 1837 with a founder who knew how to sell, it became jeweler to the world—and a place where customers are not always right

Weighing 128.51 carats, Tiffany Diamond was found in South Africa in 1877 and purchased for $18,000.

Katherine Anne Porter loved emeralds and knew what to do about it. When her novel *Ship of Fools* became a best-seller, she went directly to Tiffany & Co. to pick out some glittering gems. "Honey," she ordered the clerk, "don't show me anything small." Tiffany's somber-suited salesman probably didn't blink an eye. For 150 years, the New York jeweler and silversmith has indulged the excesses of mercantile barons, catered to crown heads of Europe and advised Presidents as far back as Abraham Lincoln on what—and what not—to buy as state or personal gifts.

Supplying Astors and Vanderbilts with million-dollar necklaces, Tiffany's a century ago had no serious rival as the nation's preeminent jeweler. But Charles Lewis Tiffany, who with partner John P. Young founded a stationery and "fancy goods" shop in 1837, never intended it to be merely a haven for the superrich. Blending the flamboyance of a diva with the probity of a deacon, he courted a mass market for his bronze statuettes, Japanese lacquerware, cutlery, toiletries and Tiffany Timer (a stopwatch).

His store has variously functioned as sponsor of scientific expeditions, standard-bearer of American craftsmanship and Barnumesque museum. Its exhibits have included the aluminum pyramid that caps the Washington Monument, gems assembled by the store's eminent mineralogist, the late George Frederick Kunz, and the 128.51-carat Tiffany Diamond—still on view (above). Now with seven U.S. branches and one each in London and Munich, Tiffany's continues to court crowds like no other temple of luxe. "In Paris the minute you walk into such a place they start counting up what you're wearing," says Paloma Picasso, who designs jewelry for the firm. "But at Tiffany's anybody can walk in and be treated equally."

That attitude has helped make Tiffany's a peculiarly American symbol of luxury. Its cofferlike Art Deco pavilion at Fifth Avenue and 57th Street remains the nation's best-known jewelry store. Its customers have included Jenny Lind, J. P. Morgan, Josh Logan, Ethel Merman, Diamond Jim Brady, Helen Keller, Elizabeth Taylor, Estée Lauder and John F. Kennedy. Its commissions have ranged from crafting a solid silver bicycle for Lillian Russell to redesigning the Great Seal of the United States.

In an era when Europeans belittled the work of New World artisans, Tiffany's repeatedly carried off the honors at international expositions, establishing its silversmiths as the peers, if not the betters, of any, anywhere—a role it jealously and successfully guards. "In everyone's mind," explains Selwa Roosevelt, who as U.S. Chief of Protocol selects gifts given by the President, Vice President and Secretary of State, "Tiffany's is synonymous with quality and American craftsmanship."

Tiffany elegance dominates this 19th-century lady's dressing table: silver box, vase, clock, frame et al.

As a self-appointed teacher of manners and style, Tiffany's brought civilizing zeal to retailing. In the words of master merchandiser Walter Hoving, who purchased the store in 1955 to save it from a takeover, and in so doing rescued it from decades of stodginess: "We have got to get over this ridiculous idea that the customer is always right." Disdaining fashion, Tiffany's refuses to sell a man's diamond ring, an item it has judged "tasteless and pretentious." The store insists that engraved invitations follow the minutiae of etiquette—the honorific "Ms." has at least one barrier left to surmount. Known as a stronghold of rectitude, Tiffany's long ago became a chief provider of trophies and memorials: jeweled swords for Civil War heroes such as Adm. David ("Damn the torpedoes") Farragut, a yard-high vase for poet William Cullen Bryant in 1875, gold medals for the 1980 Olympics, the Congressional Medal of Honor and the Super Bowl's Vince Lombardi Trophy (opposite).

By way of a sesquicentennial salute, two museums are currently exhibiting some of the company's creations: New York's Metropolitan Museum of Art, "Triumphs of American Silvermaking: Tiffany & Co. 1860-1900," to January 10, 1988; and the Field Museum of Natural History in Chicago, "Tiffany: 150 Years of Gems and Jewelry," to February 6, 1988, when the show moves to the American Museum of Natural History in New York, where it will run from March 4 to June 5, 1988.

The man who started it all was Charles L. Tiffany (1812-1902), the son of a prosperous textile maker from Killingly, Connecticut, who seemed born to sell. His father interrupted Charles' schooling at 15 to have him singlehandedly run the family dry-goods store; only after the youth made a success of it did he return to the classroom. Perhaps the experience made him receptive some years later when his childhood chum John P. Young urged him to set his sights on merchandising in New York. Borrowing $1,000 from Tiffany senior, the partners launched their business.

It began with a grand total of $4.98

Tiffany & Young occupied a narrow storefront on Broadway opposite City Hall Park—and fortuitously next door to A. T. Stewart's department store, which was soon to become the city's largest emporium. But other portents were ominous: ravages of the Great Fire of 1835 still scarred the city, the Panic of 1837 had already ruined hundreds of businesses, and mobs of the impoverished rampaged through the streets. At the close of the store's first day, receipts totaling $4.98 seemed to presage the worst, but on New Year's Eve—when holiday shopping peaked in that era—the firm ran up sales of $679, scoring with umbrellas, Chinese

Detail of the sumptuous, gold Adams vase (1893-95) highlights encrusted semiprecious stones and pearls.

The 19½-inch-high piece juxtaposed Renaissance motifs with symbols of humble American cotton plant.

On Super Bowl trophy (renamed for Vince Lombardi), even the laces are sterling; a Tiffany design, 1966.

Designer Edward C. Moore, influenced by Japanese art, conceived Audubon tea set and flatware, c. 1870.

carvings, portfolio cases, fans, gloves and stationery.

Tiffany prowled the docks for unusual imports, bargained with sea captains who stashed small lots for private sale and won a reputation for stocking the exotic. In 1845, the entrepreneurs issued a "Catalogue of Useful and Fancy Articles," a dizzying array of shaving soaps, dog whips, Venetian-glass writing implements, American Indian artifacts, Chinese curiosities, "seegar" boxes and "ne plus ultras" (garters). That playing-card-size booklet was likely the nation's first mail-order catalog. The Tiffany Blue Book, bound in the firm's signature robin's-egg hue, has updated the selection each fall since 1877.

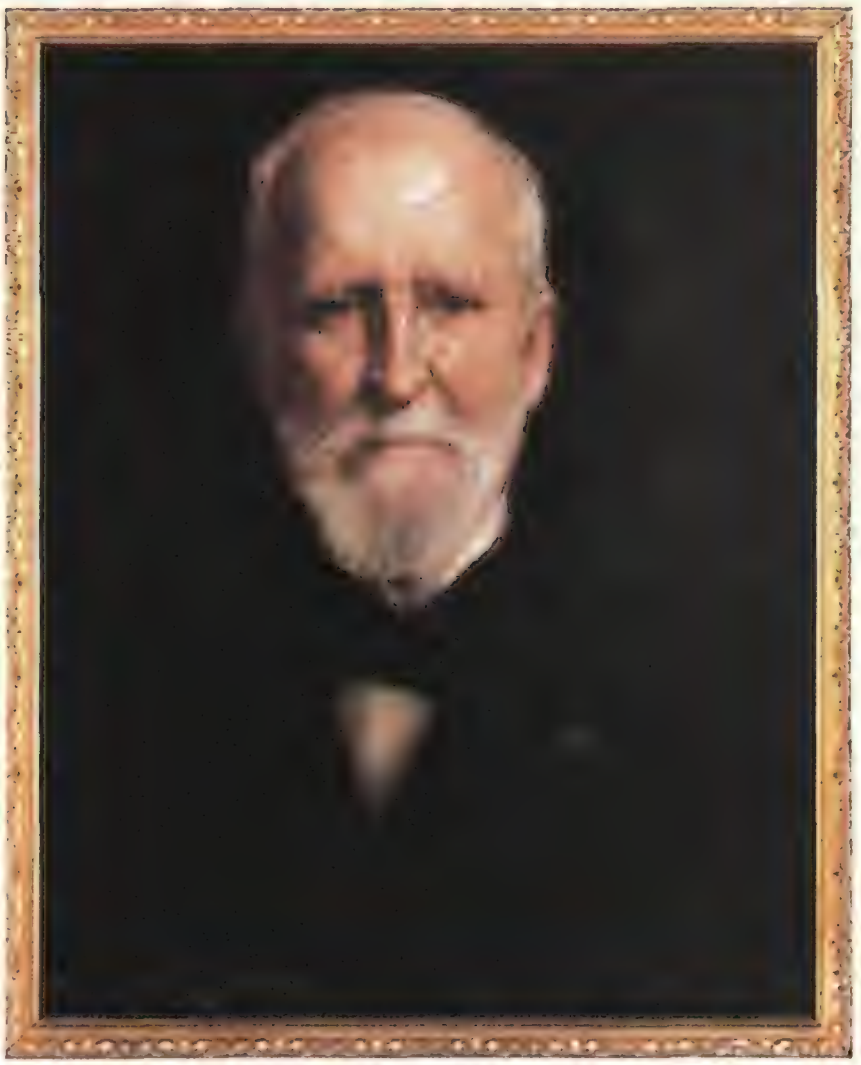
A merchant's brush with the firing squad

Gems at first played a small role, though the "best quality of imitation jewelry" was promoted. But Tiffany, Young & Ellis (a third partner had joined up in 1841) also touted itself as the "only store in New York with a representative abroad." That proved propitious. In 1848, just as Young arrived in Paris for his annual buying trip, aristocrats fleeing the revolt against King Louis Philippe dumped their diamonds on the market. Young scrapped plans to buy "novelties" and invested entirely in discounted gems. Arrested as a Royalist plotter, the jewel-laden merchant talked smoothly and saved himself from the firing squad. Afterward, Tiffany made sure that all of New York heard about Young's exploits and the new treasure. The press promptly dubbed the amiable Tiffany (not the risk-taking Young) the "King of Diamonds."

Two years later, Tiffany's opened a Paris branch, establishing access to European gem markets unmatched by its domestic rivals. Many years later the firm acknowledged that it had acquired Marie-Antoinette's zone (girdle) of diamonds, an item not seen since the 1848 mobs had looted royal vaults in the Tuileries. By breaking the zone into pieces to sell, the store claimed its origin could not be proved—and avoided embarrassing disclosures of just how the girdle had been acquired, though few doubted its authenticity.

A reputation for scrupulosity—along with ready cash and lightning-swift judgment—helped make Charles Tiffany New York's most prominent dealer of gems and Oriental pearls, then as prized as diamonds. Missing no chance to acquire a rarity, in 1856 he bought a huge, lustrous, perfect pink pearl from a New Jersey farmer who had found it in his dinner mussels. Tiffany promptly resold the pearl to France's Empress Eugénie. News of the deal reportedly "resulted in the raking of the brooks throughout the United States" (and the uncovering of no comparable pearls). When a Montana gold prospector unearthed some sapphires

Cluttered Victorian display window of Union Square store featured imports along with Tiffany's products.



In 1902, the year of his death, Charles Lewis Tiffany sat for this portrait by William Merritt Chase.

and mailed them to Tiffany for an opinion, he responded in a simple way: with a check for $12,000.

Such tales continue to inspire a flow of gem-toting hopefuls. "People call us at least ten times an hour to sell," says Peter C. Schneirla, the company's vice president for jewelry. A few of them make it to the bare, locked room—complete with binocular microscope—above the Fifth Avenue store, where Schneirla or one of six buyers examines their stones. "You make a decision on the spot," he says, "or it's gone."

Sheer financial muscle powered Tiffany's 19th-century purchases from the wobbling monarchies of Europe: most of its $1.6 million purchase of gems from deposed Queen Isabella of Spain went to the wife of railroad tycoon Leland Stanford. The firm cemented its role as the American equivalent of royal jeweler by snaring the French crown jewels at auction in 1887, including former Empress Eugénie's "great necklace" with 222 diamonds in four rows. "A very few evenings later," noted a waspish commentator, "it appear[ed] again in public at a ball on the handsome neck and shoulders of Mrs. Joseph Pulitzer," wife of the newspaper publisher. Jewel queens of a less cautious era than ours, Mmes. Astor, Belmont and Gould (and 22 royal houses that had appointed Tiffany's as crown

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Japanese Revival silver was introduced in 1876. Decorated with applied fish, insects and flowers of copper, gold or silver, "Japanesque" pieces were the inspiration of Edward C. Moore—and a hit in Paris.

jeweler) encouraged such public inventory of their tiaras, stomachers and chokers. But few of those exorbitant pieces survived intact; the stones were later ripped from their mountings and reset in newer styles. Says jewelry historian Penny Proddow, "Fine jewelry is a transient art form—you could call it snob's progress."

Fortunately for Charles Tiffany, the notoriety of his role in the century's greatest diamond swindle did not survive, either. In 1872, shortly after they learned of some stunning diamond discoveries that had been made in South Africa, two veterans of the California Gold Rush appeared in San Francisco toting bags of rough diamonds they claimed to have unearthed in Arizona. When news of the "find" leaked, mania to buy stock in their mine quickly reached New York, gripping the likes of Gen. George B. McClellan, August Belmont and Henry Seligman (whose clan had made a fortune brokering the 1849 gold rush). But the financiers refused to proceed without Tiffany's opinion of the diamonds. Regrettably, though expert in assessing cut and polished stones, he knew little of rough gems. "They are worth at least $150,000," he judged at a hushed viewing, and in exchange for all rights to the claim, the Wall Streeters promptly plied the prospectors with four times that sum. A mining engineer hired on Tiffany's advice endorsed the claim's value after being led blindfolded into the mountains where he found diamonds scattered on the ground.

Only the pride of a government geologist, who had surveyed the region of the purported mine and found no diamonds, undid the fraud. He led a party to the site, which was actually in Utah, and discovered a

Daniel Cohen's previous articles for SMITHSONIAN *have told the corporate history of the Automat (January 1986) and of Dover Publications (July 1987).*

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partly cut diamond among the roughs. It had slipped into the buckets of poor-quality South African stones the plotters had bought in London and salted there. "Most adroit and skillfully managed," opined the *New York Times* of the fraud. "I had never seen a rough diamond before" was all Tiffany could say, having lost $80,000 of his own in the swindle.

But Tiffany soon found someone who could remedy his own lack of field experience. Mineralogist George Frederick Kunz was just 20 years old when he appeared at Tiffany's in 1876 proffering North American semiprecious stones that he (but few others) prized. Tiffany not only bought them, but within three years named Kunz vice president and chief gemologist. "Kunz almost singlehandedly created the market for tourmalines, citrines and American sapphires," notes George E. Harlow, curator of minerals and gems at New York's American Museum of Natural History.

"Like a Wild West show gone to Paris"

A whirlwind of activity, Kunz traveled to every state to catalogue gem and mineral resources. (As late as 1970, a site he named in North Carolina yielded the continent's largest cut emerald, which Tiffany's made sure to acquire.) The store sent Kunz's dazzling North American collection to the 1889 Paris Exposition, where it also exhibited enamel-on-gold replicas of American wildflowers, a pink-pearl choker in Hupa Indian patterns and precious-metal bowls inlaid with Navajo designs. The pieces were displayed in boxes made of cherry, maple or California redwood covered with the skin of iguanas, elks, raccoons or alligators. "It was like a Wild West show gone to Paris," suggests Debra Healy, a jewelry designer. But it was Paris that went wild: Tiffany's took the Grand Prix.

Eventually financier J. P. Morgan purchased the Paris gem collection and another of Kunz's "world's fair" collections as a gift for the American Museum of Natural History, where they form the nucleus of the gem exhibits. In 1964 the gems again won wide attention when a thief known as Murf the Surf heisted Kunz's diamonds and the 563-carat Star of India sapphire from the museum. The Star was recovered, but the diamonds have never reappeared.

Kunz's enterprising spirit seems sedate compared with the inclination of Tiffany himself toward spectacular projects. Phineas Barnum, whose museum in the early days stood six blocks from Tiffany's, often provided the foil or, in the case of Mr. Forepaugh, a circus elephant slain because he had killed eight men, the hide. Tiffany hung the skin in his window and offered luggage made from it. When Barnum announced the forthcoming nuptials of celebrated midget Gen. Tom Thumb and two-foot-six Lavinia Warren, Tiffany's fabricated the ultimate gift: a tiny horse and carriage of filigree silver set with rubies and garnets. It topped their Matterhorn of wedding presents —after several weeks in the store's window.

Louis Comfort Tiffany likened his jewelry to little missionaries of art trying to convert the Philistines.

And when Tiffany's put pieces of the Atlantic cable on sale, only the police could restrain the crowds. In 1858, Cyrus W. Field finally reached the Irish coast with his transatlantic telegraph link. Tiffany acquired 20 miles of cable salvaged from earlier attempts and sold four-inch snippets for 50 cents apiece, as well as cable-decorated canes, umbrellas, paperweights, watch fobs and lapel pins—all with a certificate from Field swearing to the sample's authenticity. The City of New York later asked Tiffany's to make for Field a medal and a gold snuff box engraved with scenes of the cable laying. By then, few seemed to care that the cable, once again, had broken.

One spectacle that Tiffany banished from the premises, however, was that of clerks and customers haggling over prices. He astounded the trade by tagging even the most expensive jewelry and refusing to budge from the figure. With rare exception, everyone pays

A collage of fantastic jewelry designed by the late Jean Schlumberger demonstrates his masterful use of precious and semiprecious stones and enamel. Based at Tiffany's, he redefined U.S. fashion in jewels.

full price—as Dwight D. Eisenhower discovered on a visit when he smilingly asked if the President got a discount. "Well, we didn't give any discount to Lincoln," murmured a senior executive. Honest Abe had indulged his wife's well-publicized taste for jewelry by spending $2,600 for a pearl necklace, earrings and other pieces; Ike's purchases are not recorded.

It was in 1863, during the Lincoln years, that the police once again had to protect the store, but this time from the fury of Civil War draft rioters. An ardent Unionist, Tiffany had turned the showrooms into a supply depot, assembling the kinds of equipment used by the French Army and stockpiling caps, boots, blankets and armament. He also sold vast quantities of gold braid, insignia and officer's swords. Tiffany's tradition of retooling for war was to continue. During World War I it made surgical instruments; in World War II it hand-worked aircraft-engine parts for the raids on Japan led by Gen. James H. Doolittle.

But it was in silver that Tiffany had planned to make his mark. In 1851 he hired John C. Moore, the best-known silversmith in New York, to work exclusively for him. At Tiffany's insistence, Moore matched the purity of English sterling: 925 parts silver per thousand, with a trace of copper for durability and strength—a standard for sterling that became the basis for federal law. When Moore retired, he was succeeded by his son, Edward C. Moore, whose 40-year tenure brought the store international fame for its silver.

After partners Young and Ellis retired, Tiffany & Co. moved uptown to 550 Broadway, where, above the door, a carved-wood Atlas shouldered a huge clock. Today the figure monitors the store's Fifth Avenue entrance, having followed along through three more relocations. New Yorkers still tell the story of how the clock stopped at the exact moment of Abraham Lincoln's death, 7:22 A.M. on April 15, 1865.

Under the guidance of Edward C. Moore, Tiffany's silver workshops grew from a handful of artisans to 500 and adopted mechanized processes, which were new in those days. His utilitarian but elegant tea sets, from regular stock, won a prize at the 1867 Paris Exposition, the first time an American silver company was so honored by a foreign jury. European silver houses,

whose florid one-of-a-kind entries Moore had bested, were impressed and some bought his pieces as patterns.

During visits abroad, Moore became captivated by Japanese art and began collecting Orientalia. In the early 1870s he started using marine and insect designs (p. 58); he created "Saracenic" objects with intricate Islamic-style inlays of enamel, ivory and precious metal. At the 1878 Paris Exposition, the firm took the Grand Prix in silverware, and Charles Tiffany was admitted to the French Legion of Honor. For the next 25 years, Tiffany's amassed an impressive number of prizes at world expositions, key style-setting events.

As Tiffany's director of silver manufacturing, Moore oversaw the $80,000 Mackay silver service, the most extravagant, ornate and publicized table setting of its time. After John Mackay delivered a half-ton of silver from his Comstock Lode in Nevada to the firm's workshop, 200 silversmiths labored for two years to fashion the set's 1,250 urns, platters, compotes and other items; it featured an arboretum's worth of sculpted floral decoration and touches like elephant-trunk feet. In the same period, Moore guided the creation of classic flatware patterns that, with little alteration, remain in production. One, for example, Olympian, has fork-handle portrayals from Greek mythology. "Gruesome Renaissance Revival," comments today's executive vice president and design director, John Loring.

Moore also influenced the founder's son, Louis Comfort Tiffany, who was a leading exponent of Art Nouveau, though not through the family store. Although LCT (as he signed much of his work) did become vice president of the firm when his father died in 1902, mystery shrouds the contributions he actually made during the 14 years he held the title. Loring points to design albums of nature studies and jewelry sketches: "These drawings are 100 percent Louis Comfort Tiffany-style—his concern with the whiplash noodle curve. But there's no way to prove it; they're all unsigned." Rejecting a merchant's life, LCT became a painter, then founded an interior design group. Later, with Tiffany Studios, he won his greatest notice for stained-glass lamps and windows, and iridescent hand-blown glass called Favrile, a variant of the Old French word for handmade.

Tapping a flood of immigrant artisans in the late 19th century, Tiffany's increasingly turned from importing to manufacturing. In 1894 it built a vast turreted factory in Newark, New Jersey, then one of the nation's leading silverware-making cities. There, 800 employees produced 25,000 different items, including sterling flatware and hollow ware, and the silver plate favored by Delmonico's and the Union League Club (the plate was discontinued in 1930 when silver prices fell so low that sterling cost little more). Workers also turned out exotic leather goods, stationery bearing the Tiffany watermark, and hand-engraved invitations, announcements and writing paper. "The elite were the copperplate engravers, who came to work in cutaways and top hats. They rarely spoke to the others," recalls Albert Grosskreutz, former superintendent of silver, who retired in 1983 after a 37-year career.

Engravers to the rich and famous

With its cachet as engravers, Tiffany's stationery announced not only births, weddings and balls for the Four Hundred, but the dedication of the Statue of Liberty, the White House wedding of President Grover Cleveland, the opening of the new New York Stock Exchange building in 1903 and of the George Washington Bridge in 1931. But its finest engraving hour may have come in 1885, following a public outcry over errors in the Great Seal of the United States, the emblem of authority for diplomatic documents and the dollar bill. Designer James Horton Whitehouse replaced 6 arrows (too few) with the correct 13 and put a sturdy American bald eagle where a scrawny bird had perched since 1782.

The company abandoned the Newark castle in 1985 (it may go condo) and now contracts flatware and stationery to outsiders, although, it insists, with strict specifications. Its own craftsmen occupy a warehouse corner in Parsippany, New Jersey, but they remain a proud band. Asserts veteran silversmith Gero Grohs, "We can still do everything we did at Newark, except the detail work. And I think that will come back." One custom job the shop still prizes is the annual Super Bowl trophy. Hefting the halves of the sterling football that crowns it, Joe Laczko, who has created the 104-ounce award for the past 15 years, points out, "When it's done, the seam is invisible. Even the laces are sterling."

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P E R F O R M A N C E

Jewelry designer Paloma Picasso wears her own creation, characteristically big, bold and colorful.

Tiffany's jewelry makers have a better address. Sixty-five of them now work in a north-lighted penthouse that overlooks Central Park, possibly the best studio space in town. There they design, manufacture, mount and polish. But even in splendid isolation, working with minuscule stones has its hazards. Admits setter Ron Brandon, "We've spent many hours searching the floor for the ones that drop."

Despite Tiffany's enduring fame, following its founder's death there was nearly a half-century when the corporate fireworks all but stopped. True, in 1905 the store created a sensation by building itself a 16th-century-style Venetian palazzo on Fifth Avenue at 37th Street (it was given National Landmark status in 1978). But Edward C. Moore's son John, who took over as president in 1907, abhorred publicity. So did John's son Louis, who succeeded him in 1938, though he moved the store to its present, priceless site. The merchandise became staid and predictable, and sales in the 1950s sagged to less than half the level of a generation before. "Bland, syrupy interpretations of 18th- and 19th-century styles based on pretension," comments John Loring of the period. Senior salesperson Harry Ward recalls, "The diamond cases had five dignified gentlemen, who had earlier worn tailcoats, waiting for the carriage trade to come by." Even Holly Golightly, the gamine of Truman Capote's novel *Breakfast at Tiffany's*, embraced the store as a bastion of calm and sophistication (inspiring tourists ever after to ask when breakfast is served). But she associated the place with "wrinkles and bones, white hair and diamonds."

Walter Hoving changed all that by ushering in what has been called the "second golden age." He promoted "good taste—our own" and to define it assembled a dazzling team of designers starting with internationally renowned Van Day Truex, whose bamboo-shaped flatware pattern is still linked to his name. Hoving allowed cultured pearls into the store; to get rid of overly sentimental pieces he held the first clearance sale in 118 years. "Hoving taught America how to set the table, how to line up the glasses, menus and place cards," says Letitia Baldrige, Tiffany's first public relations director. He also initiated an ongoing series of in-store table settings by its celebrated clientele, among whom were Clare Boothe Luce, Cary Grant, Gloria Vanderbilt and Andy Warhol, whose "Dinner in Jail" featured bread and water served with vermeil and crystal. Hoving recruited French jewelry designer Jean Schlumberger (p. 61); other prominent designers followed: Angela Cummings, Donald Claflin, Elsa Peretti, Paloma Picasso (left).

Tiffany's most important jewel, however, remains the company itself, which has been sold and resold in the past decade. When Avon Products Inc. owned it, the sales clerks got cash registers—but they still tap on the countertop for a messenger. The blue-chip patrons recoiled at other merchandising techniques. "People thought, 'Ding dong, Tiffany calling,' " quips a gem dealer. Then came a buy-out by management. "Tiffany's had gotten confused as to what it should be," says current chairman William R. Chaney, who staged his own kind of sale last spring when he took the firm public via the New York Stock Exchange—and sold about $100 million worth of shares.

In the best Charles Tiffany tradition, the company continues to look abroad—not for crowns and kudos, this time, but for customers: in West Germany, Switzerland, Italy, Japan. Meanwhile, back on Fifth Avenue, the founder's knack for attracting passersby lives on in the discreet storefront shadow boxes where ice tongs clasp a square-cut diamond, and crystal goblets perch on the antlers of a stuffed reindeer.

Designer Elsa Peretti styled this sensuous crystal candlestick and fishbowl—but not the prop fish.

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THE BAYS

OF HUATULCO

Paradise Found

By Caroline Grodinsky and Michael Stüwe

With lots of help, alpine ibex return to their mountains

Once down to 50 individuals in the Italian Gran Paradiso, these rugged goats now number more than 20,000—all the way across the Alps

Opposite: an alpine ibex, growing old at 17, keeps a wary eye on human intruder in his mountain domain. The species was reintroduced to the Swiss Alps in the Graue Hörner region (above) during this century.

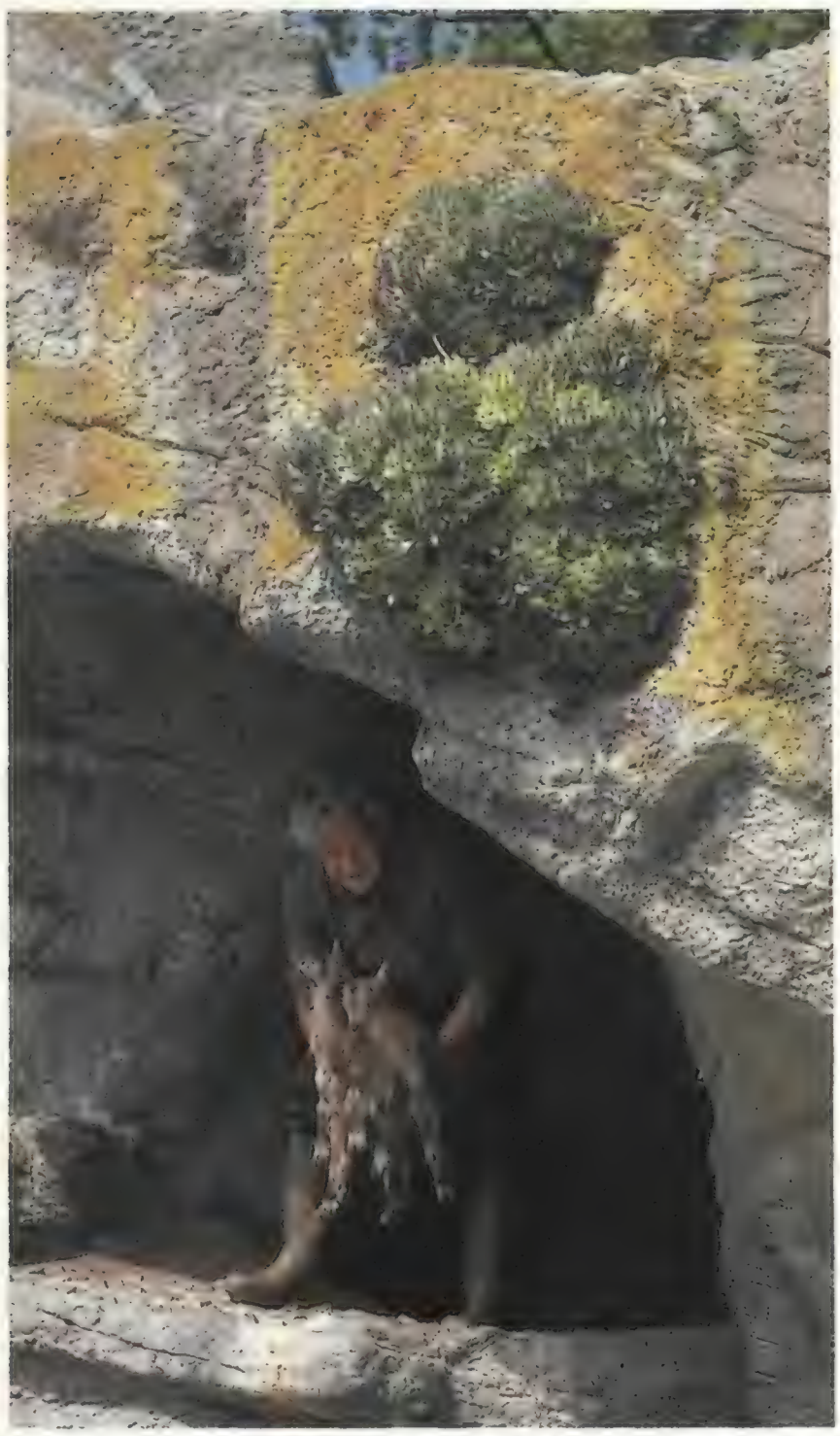
A herd of alpine ibex rushes up the rocks, circles them and then looks down at us inquisitively. Longtime zookeeper Carl Zwiker has entered their enclosure at the Peter and Paul Wildpark in St. Gallen, Switzerland. As he climbs the artificial mountain, the ibex barrel down to the opposite side of the pen. Zwiker manages to separate four yearlings from the group and presses them into an adjacent enclosure. There he directs one animal into a small chute and slowly walks after it. The ibex goes wild, jumping from a standstill onto the chain link fence, from there to the ceiling and back to the ground. Meanwhile, Wilhelm Gruber, from Innsbruck's Alpenzoo, has brought a crate to the sliding door of the chute. Quickly, Zwiker grabs the animal by its horns, lifts it off the ground and then, as Gruber opens both sliding door and crate gate, carefully pushes the ibex into the box.

The two men are preparing a shipment of 14 animals from Switzerland's oldest and most productive ibex-breeding facility, in St. Gallen, to Austria's Alpenzoo. After three weeks of quarantine in Innsbruck, the animals will be sent to different parts of Austria, and then airlifted by helicopter to some of the most remote regions of the Austrian Alps for release.

This restocking, which began more than 75 years ago, is one of the most successful conservation projects ever attempted: the reintroduction of captive-bred alpine ibex into the European Alps. Although the project is little known beyond the alpine countries, the results compare with the bison's dramatic return to the American plains in the early years of this century. Today an estimated 22,000 ibex inhabit the Alps. Efforts like those in Austria are under way in other countries, too, and soon ibex may again inhabit all of their former range.

The alpine ibex (*Capra ibex ibex*) is a mountain

In 1907 keeper J. Näf cared for the three yearlings that eventually initiated the Swiss breeding program.



Keeper Carl Zwiker holds two kids that require veterinary treatment at Peter and Paul Wildpark.

goat adapted to the highest, most barren regions of the Alps. Thick, heavy fur protects it against harsh winter storms. Its large stomach can hold great quantities of bulky, high-fiber food. The hooves reveal the most remarkable adaptation: the hard hoofwall can grasp tiny footholds in vertical cliffs, while the soft rubber-like interior works like a stopper when it is pushed forward with each step on steep inclines. Ibex hooves can also spread farther apart than those of any other cloven-hoofed ruminant, making ibex better adapted to climbing steep, rocky habitats than even their close mountain relative, the chamois.

Man's association with ibex goes back tens of thousands of years. Cave paintings in France and Spain dating from the last Ice Age depict them as game animals. During the Middle Ages, they were held in high esteem. As people recognized their ability to survive in the inhospitable regions of the Alps, a belief in the ibex's mystical powers developed. These convictions were strengthened by the animal's status as an astrological sign: the tenacious Capricorn.

Because its body parts were believed to cure a wide range of ailments, a whole assortment of folk remedies were contrived. One pharmacy in Salzburg specialized exclusively in ibex medicines; all body parts were used. Ground horns were for fighting off colic, cramps, morning sickness, poisoning and fever; ground heelbones were administered as aphrodisiacs. Blood, still hot from a fresh carcass or mixed with fermented parsley, was drunk to prevent bladderstones. Heart and bone marrow increased energy, strength and

toughness. Fecal pellets ground up with peppercorns and mixed with honey and wine cured blood deficiencies, tuberculosis and pneumonia. The heartcross, a small cross-shaped structure that forms when the base of the animal's aorta calcifies, was worn as an amulet to bring good luck and ward off evil.

Until the 15th century, ibex populated the entire alpine range. Although humans valued them as game, hunting them entailed many risks. The short range of primitive firearms gave ibex the advantage in these treacherous areas. The development of weapons with improved accuracy over longer range, however, gradually gave hunters the edge. The ibex's superiority in the steepest terrain actually led to their demise. Even at short distances they felt secure as long as they could retreat onto cliffs. But because their silhouettes stood out clearly on the barren ridges above the tree line, they became easy targets for the new weapons.

Before long, the hunting of ibex again became difficult: too few had survived the new weapons. Records of their decline exist from as early as the 16th century. In 1500, Emperor Maximilian I complained that farmers with their improved firearms were killing off all the ibex on his Austrian lands. During the 17th century, the only remaining Austrian ibex colonies were on lands ruled by the archbishops of Salzburg. Even these were overhunted and eventually disappeared because the archbishops could make a sizable profit selling the carcasses to apothecaries. An anti-poaching law enacted in 1772 illustrated the appeal this species still held for church and aristocracy. Poachers were sentenced to ten-year jail terms, in addition to a penalty of 50 lashes each year on the anniversary of the prohibited deed. If caught poaching again, the offender's hand was cut off and he was imprisoned for life.

A wave of extermination moved over the Alps

The wave of extermination had moved quickly over the Alps in a southwesterly direction, leaving the highest and least accessible peaks as last retreats. Even there, the ibex were ultimately hunted. Protective laws, enacted in Switzerland as early as 1556, proved ineffective; ibex colonies continued to dwindle. The last Swiss ibex was shot in 1809.

Only in the Gran Paradiso massif, just across the border in Italy, did some small colonies survive. Although seemingly destined for the same fate as their northern and eastern relatives, they were to become the ancestors of all today's alpine ibex. In 1821, when about 50 animals remained, a forester named Joseph Zumstein persuaded local officials to enact and enforce tough protective laws. The ibex's safety was finally assured when King Victor Emmanuel II could be con-

At Peter and Paul Wildpark, ibex frolic on artificial peaks built in 1902 by sculptor Urs Eggenschwiler.

vinced of the treasure he possessed in his alpine valleys. The world's last ibex were designated royal game under direct protection of the king. He alone could appoint the royal hunters and it was considered the highest honor to accompany him on an ibex hunt. One hundred fifty soldiers were assigned to protect the herd, and by the time Victor Emmanuel died in 1878, the ibex population numbered about 500.

As Zumstein struggled to save the ibex in Italy, the Swiss Alpine Club and other conservation groups were already planning the reintroduction of ibex into Switzerland. One effort eventually failed. From 1815 to 1879, zoos in several Swiss cities experimented with crossbreeding domestic goats with ibex. The hybrids were cute as kids; as adults they were fertile—but they also turned aggressive, attacking tourists and keepers alike. Worse, the hybrids did not do well when released into the wild. Hybrids kid in early March, still in the alpine winter, while purebreds kid in late May and early June, after the snow has melted and spring growth is abundant for grazing. When nutrient demands of hybrid mother and kid were highest, only low-quality forage was available. These offspring, born in a cold, damp, unfavorable season, had a slim chance of survival.

In 1902, after a half-century of unsuccessful attempts with hybrids, a commission at the Peter and Paul Wildpark decided to establish a Swiss colony of purebred ibex. In Italy, they had recovered to an estimated 3,000 head by the turn of the century. All Swiss attempts to obtain breeding stock through diplomatic channels failed, however. The Italian king refused to sell. He alone ruled the world's only ibex colonies and he intended to keep it that way. The Wildpark, by sparking the king's interest in ibex, had unwittingly blocked its own chances of obtaining animals.

Since a legal purchase seemed impossible, the commission finally accepted the offer of one G. Bérard, a well-known animal dealer of dubious reputation. He would transfer three kids to Wildpark officials across the Italian border. The price was set at 800 Swiss francs each, higher than the cost of a top-quality dairy cow, Switzerland's most valued livestock. On June 6, 1906, three 4-week-old kids were smuggled out of Italy. Although the arrangement was obviously illegal, the minutes of the July 3, 1906, business meeting of the Peter and Paul Wildpark, as well as listings in many subsequent publications, neatly refer to this event as the "acquisition of three young, happy and healthy ibex kids."

Between 1907 and 1917, the commission purchased for 1,000 francs each an additional 12 males and 19 females, most of them between 3 and 4 weeks old. These "acquisitions," at first kept secret, were eventually reported, as the Italian authorities changed their export policies and began to officially sell ibex.

The first animals adapted well to their captive lifestyle and were hand-reared with ease. (Unfortunately, in the early years, little thought was given to the effects hand-rearing would have on the animals' subsequent behavior in the wild.) In the third year at the park, two females gave birth to the first kids. By 1911, further purchases from the Gran Paradiso region and more births had enlarged the Wildpark's herd to 11. On May 8 of that year, after a century of absence, the first ibex were released back into the wilds of the Swiss Alps. The reintroduced group consisted of the 3-year-old male Peter, the yearling male Paul, two 2-year-old females (one of which was already pregnant) and one yearling female.

From the start, Peter caused problems. One of the first hand-reared kids, he was quite comfortable around people. Shortly after his release he wandered away from the colony toward the village of Weisstannen. There he begged for bread from spa guests and tourists and, even worse, paid visits to the village house goats. His reprehensible conduct was immortalized locally by a folk song entitled "The Knight from Rappenloch." After all the money, effort and time invested in establishing a colony of purebred ibex, the Wildpark could not afford the possibility of its being polluted with domestic-goat blood. Realizing that Peter would never shake his fondness for humans, rangers returned him to the Wildpark, where he died three years later from mange.

In the fall of 1913, after two years in the mountains

The authors worked together on the genetics of alpine ibex populations. Grodinsky is at the New England Regional Primate Research Center; Stüwe spends his time at the University of Zurich and the National Zoo's Conservation and Research Center in Virginia.

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Two yearlings butt heads as they play-fight on what for most other animals would be precarious footing.

The central parts of ibex hooves change shape like rubber stoppers to give them extraordinary traction.

with his females, the second male, Paul, wandered away from the colony. During his excursions he, too, encountered house goats and during the rutting season fathered six hybrids. When it became clear that Paul preferred house goats to ibex, game wardens shot him, fearing he would introduce goat blood into the purebred colony. He was stuffed and put on exhibit at the natural history museum in St. Gallen to serve as a symbol of the extraordinary return of the ibex to Switzerland.

But initial excitement about the ibex gradually faded. The colony did not grow as expected. Although several offspring were born during the first years, progress was slow. By 1928 the colony numbered only 40. Thereafter it actually decreased until, by 1937, only two bucks remained. Between 1941 and 1961, an additional 25 ibex were released and the situation slowly reversed itself. This probably occurred as the females relocated to more favorable habitat and the males followed. In the new location the colony prospered and, by 1975, even with heavy avalanche losses, numbered 150.

The colony's early problems had stemmed largely from a lack of information about appropriate ibex habitat and from the influence of some of the park's financial backers. Because they wanted a release in their own canton of St. Gallen, the Graue Hörner region was the site picked. Later, the commission realized it had made a poor choice. Ibex thrive above tree line in regions between 2,000 and 3,000 meters (roughly 6,000 and 10,000 feet) above sea level. At 1,690 meters the release site was not only too low but it was not sunny enough and precipitation was too high. Clear-cutting had reduced the amount of available forage for the ibex, whose winter and spring diet is 75 percent pine needles. The lack of trees also had made the area more vulnerable to avalanches. In the largest known accident, 22 animals died in one avalanche. In addition, the government had provided only enough money to restock the colony with three ibex per year. These could not replenish the losses.

The failures and successes of the "mother colony" helped biologists determine better strategies for future ibex releases; the first at Graue Hörner had also stimulated interest among other organizations. A new commission, Wildpark Interlaken-Harder, was formed

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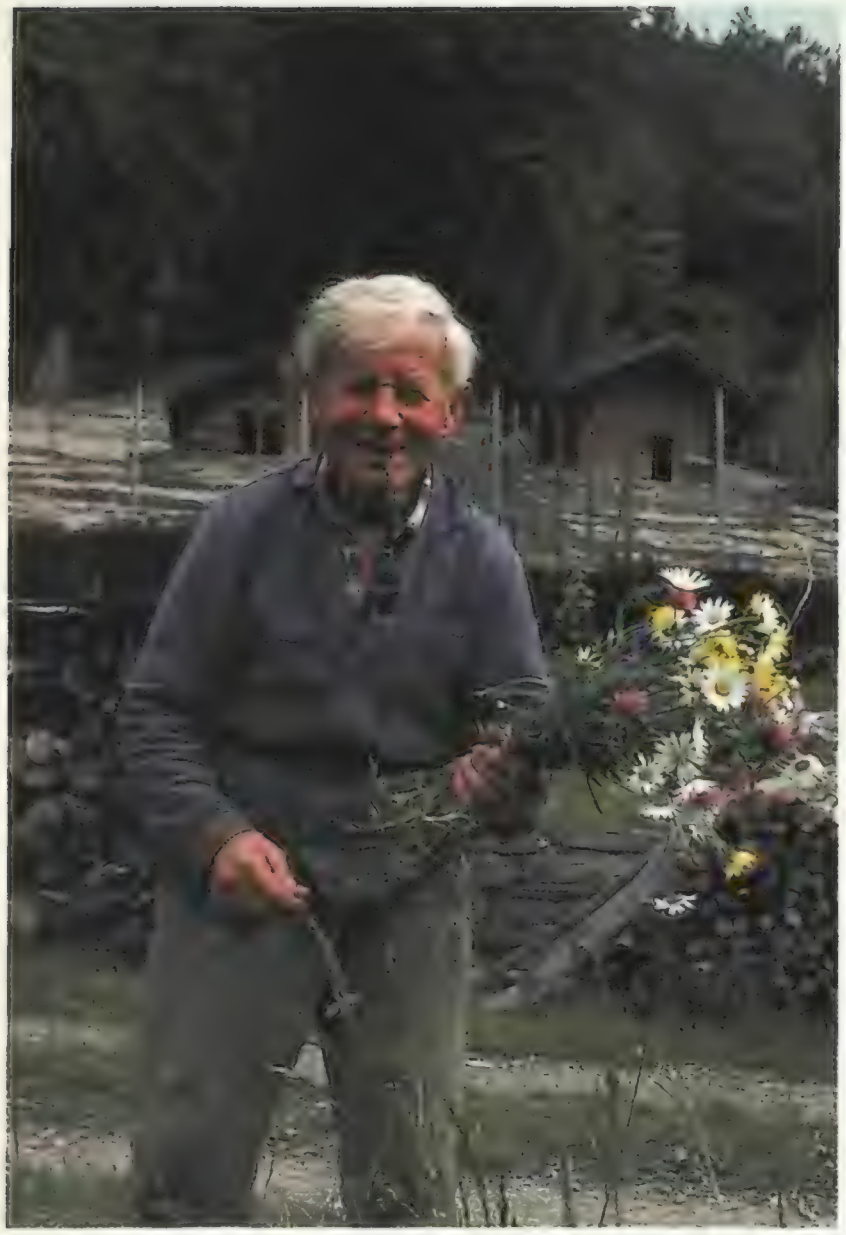


Fritz Stegmann is keeper at Interlaken-Harder Wildlife Park, another center for ibex breeding.

in 1913 to build a facility for breeding ibex. Animals bred at this park would be released in the mountains of the canton Bern.

As it turned out, the first "Interlaken ibex" went elsewhere. The Swiss government wanted ibex in a new national park, and because the commission desperately needed money it sold four to the government. On June 19, 1920, the animals were released, along with three from Peter and Paul Wildpark, on Piz Terza mountain.

More releases followed. By the early 1940s, six new and successful colonies had been established from animals bred at the two parks. By 1952, three of the original eight colonies—Piz Albris in Graubünden, Augstmatthorn in Bern and Mount Pleureur in Wallis—were growing rapidly. Since then, all Swiss colonies have been founded from wild stock captured largely at Piz Albris, Mount Pleureur and Augstmatthorn. Piz Albris alone has provided more than 2,000 ibex for release throughout the Alps. When Christoph Graph of Munich University surveyed ibex colonies in all the Alps in 1977, the success of the isolated efforts of the past decades became apparent. In that year a total of 108 colonies with approximately 14,000 animals already existed in the alpine mountains of Switzerland, Italy, Austria, Yugoslavia, France and Germany. Even without more recent surveys, biologists estimate that as many as 22,000 ibex inhabit the Alps today.

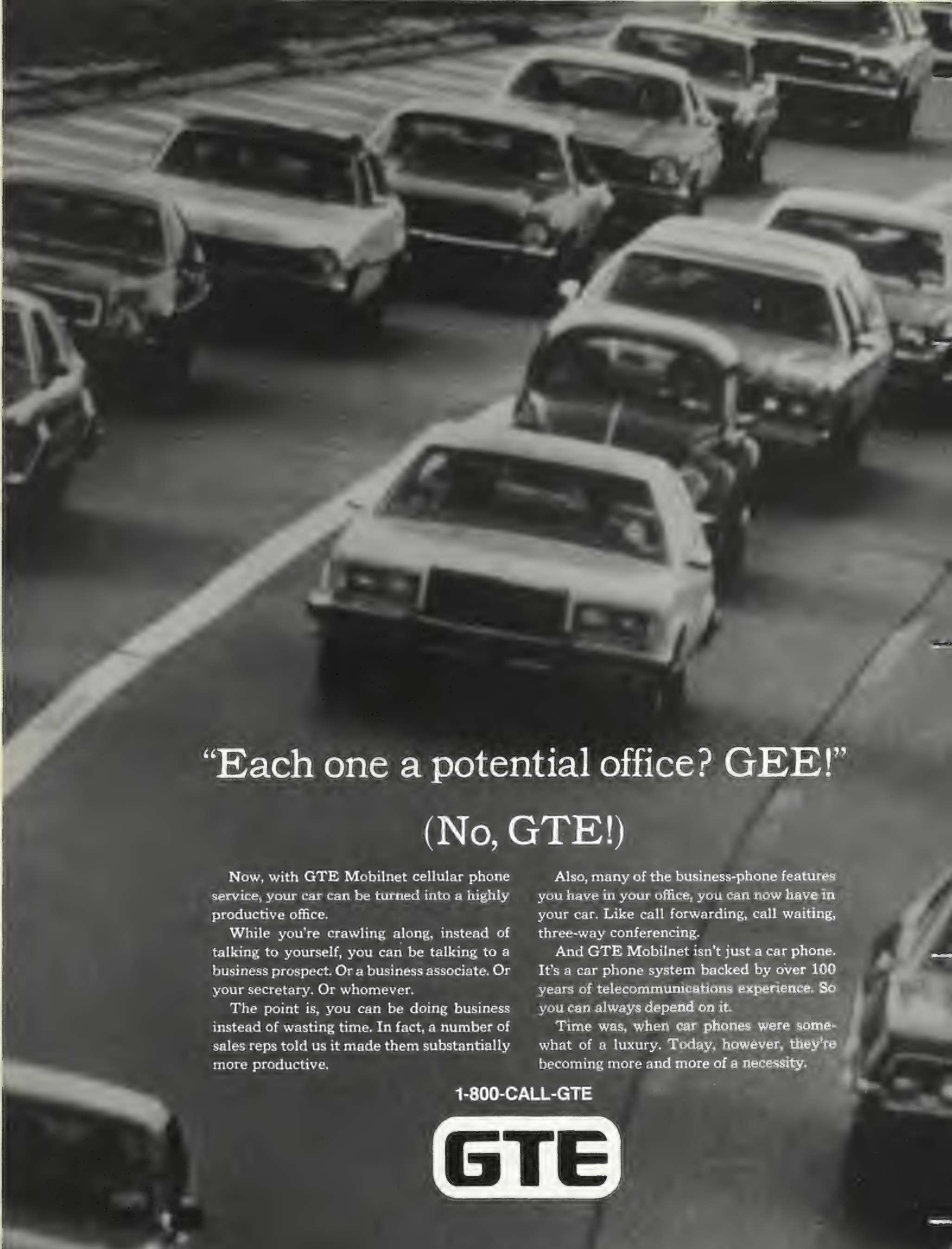
The growth of the colonies caused new problems. Fourteen years after the first release in the Berner Oberlands, the Swiss government reacted to public pressure and organized a council to discuss damage done by ibex in that canton. The danger, then and now, is that their browsing damages the trees that protect villages and towns in the valleys from avalanches. Farmers and hunters also complained that the colonies were too large. Ibex compete with livestock for limited alpine pastures, and their increased numbers seemed responsible for a drop in the number of chamois, a favorite game species, sharing their habitat.

The tables had turned again. Ibex, which a few decades earlier were in great demand, now competed with Man. Their numbers were now to be reduced by government policy. At first, game wardens captured ibex and relocated them to new territories. Soon trapping could not keep up with the rapid growth of some populations and hunting became the only acceptable alternative. Under Swiss law ibex are a protected species and hunting was, and still is, forbidden. The government decided, however, to allow canton forestry departments to issue damage-control permits.

In 1977 in canton Graubünden, and in 1980 in canton Bern, the first controlled ibex hunts were conducted. Since then other cantons have coordinated hunts, and by 1982 as many as 600 ibex were being culled annually in Switzerland. Unfortunately, hunting has changed the behavior of the animals. Once tame, curious and undisturbed by the presence of hikers, they are retreating deeper into the mountains. Before hunting began at Brienzer Rothorn, passengers on Switzerland's last steam train up the Rothorn saw numerous ibex along the tracks. Today they are lucky to spot one far away.

As much as it may seem necessary to kill ibex in certain areas, we can hope that someday the words of one of Switzerland's great naturalists, Emil Bächler, will again ring true: "The purpose of ibex reintroductions in Switzerland was never to sacrifice this magnificent mountain ungulate to the bullets of hunters." Biologists must now deal with success.

A 5-year-old male keeps watch from a craggy slope in terrain that is typical of its preferred habitat.



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Grace Phillips Johnson Gallery, Enid, Oklahoma

Travel in the Western states inspired many of Blakelock's paintings after he returned to New York.

By Abraham A. Davidson

The wretched life and death of an 'American Van Gogh'

Ralph Blakelock's landscapes once sold for astounding amounts—but the artist lived in poverty, dying after years in insane asylums

Indian Encampment along the Snake River, 1871, combines minutely executed figures with landscape.

As has happened too often to artists of genius, fame came too late to Ralph Albert Blakelock. By 1916 he was a national celebrity, his work acclaimed at last, but he had long since been diagnosed as schizophrenic and for the past 17 years he had been confined to a mental hospital.

The pallbearers at his funeral in New York on August 14, 1919, included officials of the National Academy of Design, the National Arts Club and the board of trustees of the Metropolitan Museum of Art. After the funeral, President Woodrow Wilson reportedly sent a message: "'It would have been a great pleasure to me to join in the tribute of deserved praise paid to Blakelock. I wish I might have had the privilege of paying my respect to his memory in person."

Of the many ironies throughout the history of art, this was one of the most terrible. It was for good reason that, for a time, Blakelock became known as the American Van Gogh. He was abused, mocked and counterfeited. His family, including nine children (one of whom died in infancy), lived in poverty while he went out to peddle pictures nobody wanted.

Having become intrigued by Blakelock and the shift in his work that followed early travel to the West, I spent two years following every lead possible in search of the man and his art. I went to Boston's Vose Galleries, which handled many of his paintings and where his son Allen was once employed; to the Sheldon Memorial Art Gallery at the University of Nebraska in Lincoln, where I was able to study the documents, paintings and photographs assembled by Norman Geske, now director emeritus of the gallery where the Nebraska Blakelock Inventory is kept; and to Eagle Rock, California, to meet Susielies Blakelock, widow of the artist's grandson, David. I came upon never-before-published letters of family members, his own letters from the sanitarium, and observations of attendants and doctors during his confinement.

The 11th and 12th Ralphs

Blakelock was born October 15, 1847, in New York City. His father, a homeopathic physician, was the 11th Blakelock to bear the name Ralph. Dr. Blakelock, a niece recalled, had a good income. The family included two sons, Ralph Albert and George (who also became a doctor), and a daughter. Their affluence may have contributed to the artist's later impracticality. Ralph Albert, encouraged by his father to become a doctor too, entered the Free Academy of the City of New York (later City College) in September 1864, but left in February 1866 without graduating. He had spent many summer vacations with his uncle, an artist and musician, and, through him, developed an interest in both of these subjects. Although he had some drawing classes in college, he was for the most part self-taught.

Sometime in 1869, he undertook a journey to the West, traveling through Kansas, Colorado, Wyoming, Utah, Nevada and California. In 1870, he visited Mexico and parts of Central America. The travel was financed by his father.

Information on Blakelock's sojourn in the West between 1869 and 1872 is scanty. It has long been taken for granted that there was only one journey, but a painting in Boston's Museum of Fine Arts entitled *Rockaway Beach, Long Island* (p. 84), signed and dat-

An American artist's tragic life

Ralph Albert Blakelock grew up in an affluent family, is shown in what may be his wedding picture.

Fine Arts Museums of San Francisco

Cora Bailey, Blakelock's wife, was 18 when he did her portrait. Her mother lost it as security for an $8 loan.

ed 1870 in red, suggests that he was back East between two journeys. Out West he made about 250 drawings. Among them are animal studies (horses, dogs and coyotes), Indians riding and hunting, children and women walking about a covered-wagon camp.

Blakelock apparently traveled great stretches by stage and horseback. He must have associated with the Indians he encountered, staying near wagon camps and avoiding the larger settlements and the transcontinental railroad.

Blakelock's life and art were transformed after his Western experiences. The impression made upon him by what he had seen may have been overwhelming. His view of the West differed vastly from those of artists like Frederic Remington, who was concerned with human drama. For Blakelock, humans were often small, indistinct, dwarfed by the landscape—something like a ghostly presence. From being a painter of careful, realistic landscapes, he came to paint forestscapes that appeared like memory images, scenes of things envisioned only in the mind's eye.

His forestscapes were an imagined atavistic America—innocent, undefiled, but somewhat ominous. In a night scene, the moon radiates light upon a still river, while the trees upon the bank seem to yearn upward.

In the sky, the heavy textures of mingled greens, yellows and yellow-grays represent clouds, but beyond that they may metaphorically suggest, to some viewers, layers of memory. To obtain such textures, Blakelock's daughter Ruth recalled, the artist would rub paintings with a pumice stone as he held them under a running faucet. In another forest scene, a deer, like a sudden apparition, darts out of the dark growth (p. 86). It is one of the most compelling images of a primeval and mysterious America ever presented—an image of America that is known today mainly to discerning collectors.

From the start of my investigation, I wondered what Blakelock saw in the West—or thought he saw there. It is something that will probably never be known, unless some revealing letter should turn up. The artist himself left little written record of his travels; another daughter, Marian, mentioned in a letter that she never heard her father speak of them. But it was out of these journeys that flowed the greatness of Blakelock's art.

Settling in New York City, he married Cora Rebecca Bailey of Brooklyn on February 22, 1875. Acquaintances described her as well-dressed, good-looking and carefree. Ever since his return from the West, Blakelock was determined to make his living as a painter. Cora was confident that he would soon be famous.

Things did not turn out as expected. As the 1880s progressed, the Blakelocks became increasingly impoverished. The painter insisted on supporting his growing family with his art. Though he showed at the National Academy of Design and at the Society of American Artists from 1879 to 1888, few wanted or were willing to pay much for his work. "His pictures are very original," Mrs. Blakelock once wrote, "so original in fact that when trying in vain to sell them he was constantly met with the remark . . . 'Why don't you paint like other artists?' But he would not change his method of painting as he thought he was right and in no other way could he get the effects he desired."

He wore his anxiety on his sleeve

He had no dealer. His son Carl remembered, as a youngster, walking up and down the streets of New York all day with his father, who, with rolled-up paintings under an arm, tried to sell them at any price, "but it was the usual thing then to carry them home again." Partly because he was small, weighing only about a hundred pounds, and partly because he was a poor businessman who wore his anxiety on his sleeve, dealers took particular delight in knocking down his prices. Sometime in the late 1880s, Third Avenue junk dealer Robert Fullerton paid Blakelock $100 for 33 paintings.

Although the artist turned out paintings as quickly as he could—and some were potboilers—he simply could not support his large family. "It has been said that his work was uneven," Mrs. Blakelock later wrote. "That is easily explained. His best work took a long time to complete and in the meantime he had to live. Pictures were painted to keep things going." He did "all in his power to keep the family together. His highest ambition was to make a pleasant home for us." But the family was evicted on many occasions, usually for being in arrears with the rent; sometimes their household possessions were placed on the sidewalk and they had nowhere to go.

Defeated by the poverty, Blakelock suffered a breakdown. Perhaps he could not understand why there had been so much for him while he was growing up and so little now that he was an adult. On March 25, 1891, he was found wandering on the streets of New York and was taken to Flatbush Insane Asylum. Judged to be well, he was released after one week.

Blakelock increasingly seemed to be attempting to re-create his experiences in the West. As the 1890s

Paine Art Center and Arboretum, Oshkosh

Luminous skies, often reflecting off water, are typical of Blakelock. *Seal Rocks* was painted about 1880.

Museum of Fine Arts, Boston

Rockaway Beach, Long Island was signed a second time and dated 1870, which leads scholars to speculate that the artist interrupted his travels in the West. Wind sweeps in from the ocean in this small seascape.

progressed, he began to dress as though he were still there. He kept his hair very long and had a beard; he wore sashes and belts to which he attached long strings of beads and trinkets; he carried an old dagger "which he made no attempt to conceal," his wife wrote in a letter in 1908. "I am sure he wore it only because he thought it artistic. . . . I was never afraid of him." However, the exposed dagger frightened other people and was a factor leading to his commitment.

On September 11, 1899, another baby was about to be born. To raise money, Blakelock tried to sell one of his best pictures to a collector, who offered the artist half of his asking price. Blakelock refused the sum and left, then relented and went back. But this time the collector offered an even lower price, and the desperate painter accepted. Blakelock took the money but later destroyed it. The next day the normally gentle artist became violent and was committed by his wife to the Long Island Hospital at Kings Park. This also turned out to be the day of the birth of Douglas, their ninth child.

A hospital record probably written by the admitting attendant or physician suggested Blakelock's fixation with poverty: "He threatens to kill the members of his family. He threatens to kill his son because he bought a new coat. [Claims that] he is the Duke of York. That he supports the whole neighborhood." This time the artist was not released. Diagnosed as suffering from dementia praecox, he was transferred on June 25, 1901, to Middletown State Hospital for the Insane at Middletown, New York.

In the sanitarium, Blakelock imagined himself as fabulously wealthy. A Chicago collector who came to visit him so won his confidence that the man was given "one million dollars," a bill made from the tail of a torn shirt shaped to the size of paper money. Blakelock designed other bank notes and signed sketches "A-1," to stand for Albert the First (though he was the 12th to bear the name Ralph, he was the first Albert). He informed his physicians that he had sent a gift of $9 million to the National Academy of Design, and he told a young reporter, who spent four days at Middletown to study the living conditions at the institution, that someone had stolen the Blue Diamond of Brazil from him.

Ironically, as Blakelock sank within his delirium,

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Milwaukee Art Museum

Old New York, Shanties at 55th Street and 7th Avenue is one of several such scenes that Blakelock painted around 1875. It is difficult to believe that this area of the city was so primitive only 110 years ago.

the market value of his paintings rose and rose (the sensationalism of the artist driven mad by poverty as well as the opportunism of dealers and collectors were contributing factors). In March 1913, Senator William A. Clark purchased at auction Blakelock's *Moonlight* for $13,900; at the time, it was the most ever paid for a work by a living American artist. In February 1916, that record was broken when the Toledo Museum of Art purchased *Brook by Moonlight* (p. 91) from a collection for $20,000. (Blakelock had asked $1,000 for it, but got only about $500 when he originally sold it.) For the family, not much changed; the poverty went on unabated.

Around 1907 the Blakelocks, unable to survive in New York, took up residence in a two-room cabin in Austin's Glen, near the village of Catskill. The rent was $4 a month. The only Blakelock painting they had was a flower piece done when the artist was a boy. The plight of the needy family was written of in magazines and newspapers, but although people were interested, few did anything to help them. For three years, including the day when *Brook by Moonlight* was sold, Mrs. Blakelock could not afford the fare to visit her husband.

At the Middletown sanitarium, Blakelock harbored a second illusion: he imagined himself involved in plots, especially plots directed against him. One of his rambling letters begins: "When I first came here I came here as a special counsel for 10 days in reference to the Magna Charta rights concerning commercial advantages of this hospital and was supposed to report back to Washington to the War dept. I certified a habeas corpus at Washington at the [rounds] certifying my enrollment as a habeas corpus in order to report to Gen. Sherman at the close of the Civil War. . . ." He believed that the Union League would pay a large reward for his return to New York, that the government tried to force him to pay duty on his pictures because they resembled the work of the Barbizon school and the French Impressionists. He accused the sanitarium authorities of having destroyed his business, through his wife, for 25 years. When informed that he had been elected to associate membership in the National Academy of Design in 1913 (as his work gained respect), he responded that he had been declared insane because the authorities could not remove his paintings from the state of New York.

It is bizarre that the plotting that Blakelock believed existed in a sense actually did. During his confinement, perhaps hundreds of forgeries of his paint-

Hirshhorn Museum and Sculpture Garden

A white deer is almost a ghostly presence in *The Wounded Stag.* The artist did a number of hunting pictures based on his memories and on the sketches he gathered during years he traveled in the West.

ings were being produced. At Lincoln, Norman Geske has documented 500 "Blakelocks" as being of questionable authenticity. In 1971, the Boston dealer Robert C. Vose jr. was called upon to examine, from different sources, 112 "Blakelocks"; he found only one to be the genuine article. At the time, the forgeries caused a furor. In New York, Assistant District Attorney John T. Dooling was put in charge of investigating reports of many Blakelock forgeries, but no conclusions were reached. In one instance, on May 28, 1918, he had Blakelock come to New York from Middletown to give his judgment on some doubtful paintings. In matters of art Blakelock always remained lucid.

While he was at Middletown, another tragedy befell the family. His daughter Marian was turning out soft-focus landscapes suggestive of her father's, but without his compositional tautness, his genius. She could have hoped that her father's success as an artist would pave the way for her own. Things did not work out as she might have assumed. Because her work looked too much like his and because she signed her paintings with the same surname, buyers—even dealers—stayed away. "Am I not checkmated every time I try to move?" she observed sadly. But she could not paint other than in the way she had been taught. Unscrupulous dealers rubbed out her name and put in that of her father to increase their sales and prices, and she, too, went mad. In 1915, she was sent to the Hudson River State Hospital, then to the State Hospital in Poughkeepsie, where she lived out her days. Mercifully, Blakelock was never told of Marian's confinement.

After a few years at Middletown, Blakelock began to paint again. The clamor for his work hardly touched him. There were now no rounds to make, no dealers to visit. Even so, conditions were not exactly ideal. Frequently he lacked proper materials: he painted on bits of paper, cardboard, pieces of cloth, window shades, pieces of wallpaper and wood; sometimes he made brushes from the hair of his head, sometimes from fibers stripped from a tree trunk—he wired them onto a stick, a stick he had to whittle with a piece of tin since inmates were not allowed to have knives. He gave away much of this work to acquaintances and the staff.

Blakelock must have been much encouraged in the second week of March 1916 when his wife came bringing brushes, paints and other supplies from his old friend Harry Watrous, then an official of the National Academy of Design. Her trip was financed by a newspaper, the *New York World.*

The usual subjects of the Middletown paintings are the buildings and grounds at the institution where Blakelock was taken for walks. Often there is a roughness, even a vehemence, to the execution, as in a treescape reminiscent of Van Gogh's work of the Saint-

Even the very leanest ham could use a little trimming.

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Rémy period. In the medical records, attendants noted "poor execution," "lack of finish." In one entry an attendant observed that Blakelock first colored a painting brown with tobacco juice and then scratched out part of it to leave a woodland scene. Today such a piece might be characterized as "neo-Expressionist." A landscape of this period depicts a figure, presumably Blakelock himself, standing small and isolated, huddled beneath a great arch of tangled trees. In one of the most remarkable pieces done at Middletown, a clothed woman staring toward the viewer reclines in a forest clearing (below). She seems formidable, implacable, like a divine guardian or a figure of fate, rather than a mere mortal. Or perhaps this was a figure Blakelock envisioned as his rescuer.

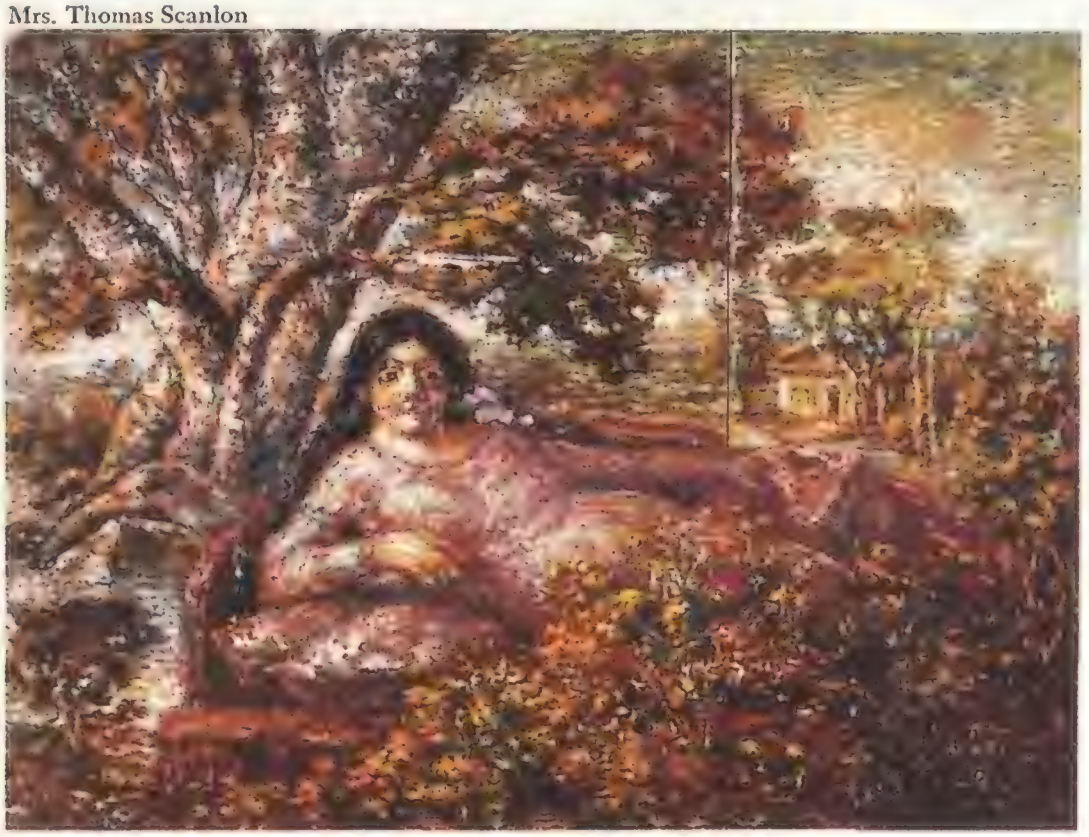
In Susielies Blakelock's collections, I found the most poignant of the artist's writings from the sanitarium. It was set forth as a message to whomever might chance to read it: "I am only 73 years young 19 of April [puzzling because Blakelock was born October 15 and did not live to age 73] if I am insane I am not conscious of it I am not a paranoic I am not in the period of senility nor aged dotage. For I can whistle and sing I am one of the many unfortunates in a long business career not even over indulging in luxurious living and trying to comport myself the best I can untill such changes come my way for the better . . . I sincerely believe hope and trust that something will come my way to release from this moral cesspool I want and a little chance and this I am looking up to through some friend that God may be pleased to send it would certainly be a Benediction of joy to walk on real earth again.

"Who can devine the messenger."

A final, painful chapter remained to be played out in Blakelock's life. On April 3, 1916, a public meeting was held in the music room of New York's Biltmore Hotel. In attendance were Dr. Maurice Ashley, director of the Middletown sanitarium, and Beatrice Van Rensselaer Adams, a woman in her late 30s who had intruded in Blakelock's affairs. Out of the meeting arose the Blakelock Fund Inc., which was to "help this artist and his destitute family." Adams, adept at self-advancement, was appointed secretary of the fund and provided it with the accouterments of a well-run business, such as stationery with an impressive letterhead giving the address of its office as 26 Liberty Street, New York City. On September 5, Ashley released Blakelock to the care of Adams and attorney John Agar, and Mrs. Blakelock was informed of this in a terse note.

For the rest of his life, Blakelock was effectively shut off from his family, Susielies said, as he was made to shuttle between the custody of Adams and Middletown. Family members knew they were pitted against the Blakelock Fund but were unable to combat it because they lacked the financial resources, the political savvy, even the emotional resolve. Even though

Mrs. Thomas Scanlon



Beatrice Van Rensselaer Adams (left) helped found the Blakelock Fund in 1916 and had the artist released to her care. She later became schizophrenic and was committed to a mental hospital. *Reclining Figure* was painted while Blakelock was at Middletown.

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$35,000 was believed to have been raised by the fund, mainly through sales, neither Mrs. Blakelock nor any of the children ever saw a penny.

From Middletown, Adams had the artist brought to Lynwood Lodge in West Englewood, New Jersey, a private sanitarium. There he was set up in a grand studio set in a beautiful landscape. Adams, her eye to publicity, had him photographed: dressed to the nines, he stood before his easel in a stiff pose hardly conducive to painting. Blakelock was urged to paint masterpieces in his old style of the 1880s but was unable to do much. Meanwhile, in order to visit her husband, Mrs. Blakelock had to secure Adams' permission, which she gave with a calculated imperiousness, as evidenced in a letter to Mrs. Blakelock of September 29, 1916: "At any time you desire to see Mr. Blakelock we will arrange to have you do so. We are endeavoring to protect him, and therefore not making his address public. . . . It is not to be expected that anyone coming here to the office unexpectedly, without an appointment, will get to see me. Please advise me a few days in advance when you come to visit Mr. Blakelock."

In March 1917, Blakelock was returned to Middletown by Adams. In 1918, she again had him taken to West Englewood and that summer to Lake George. When she brought her charge back to Middletown on November 4, according to an attendant there whom Susielies interviewed in 1968 or 1969, the artist was without any possessions, even his eyeglasses. Blakelock, then weighing but 76 pounds, told a doctor that Adams had struck him.

Remarkably, Dr. Ashley continued to release Blakelock to Adams; the painter was in her company through most of 1919 until his death, with the family being kept deftly at arm's length. Only Blakelock's sons, Carl and Ralph Melville, fought the fund—but without much success. On March 10, Ralph Melville wrote Agar that he was still trying to learn the whereabouts of his father, that he was given the wrong Lake George address and that his mother had made several trips in vain to the fund's office to find her husband. Susielies has many letters from Ralph Melville to Agar and Adams in which the son tried to pin down the father's location. The return letters were slow to come and purposefully vague or misleading. On April 24, Adams replied that Blakelock's address was "temporarily Middletown" but "not as a public charge." Blakelock was yet again released to Adams' care on July 3. He died on August 9, 1919, at 10:15 A.M. in a private cottage in the Adirondacks. The official cause of death was cited in the *New York Times* as arteriosclerosis, but according to Susielies the family reported that there was a head injury.

Frequently mentioned in the newspapers from 1916 to 1919, when she was described as a benefactor, Adams was not heard from for more than 22 years after Blakelock's death. She suddenly resurfaced on December 23, 1941, when she collapsed on the street near Grand Central Station. An exhibition of Blakelock's work was being held close by at Grand Central Galleries. Brought to a hospital, she presented conflicting accounts of her history and seemed to be withholding information. Soon afterward she was diagnosed as having been afflicted with dementia praecox, the very diagnosis given Blakelock 42 years earlier, and was committed to the same hospital where he had been taken in Kings Park.

In the Blakelock Inventory in Lincoln, I found the photostat of a letter written on January 27, 1944, by Dr. Arthur E. Soper, director of the hospital. It contains an assessment of Beatrice Van Rensselaer Adams. Her sense of persecution, according to Soper, was tied to her efforts to keep Blakelock forgeries from being sold as authentic. She believed she had a large fortune and saw herself as a great philanthropist, Soper wrote. She believed she had many prominent friends, although she was never visited and never received a letter. Blakelock, from the grave, could not have devised a more ironic final chapter.

Even while their father's paintings brought large sums, Blakelock's children lived in a two-room cabin.

Brook by Moonlight sold for $20,000 in 1916, at the time a record for the work of a living American artist.

Toledo Museum of Art

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By Douglas J. Preston

A daring gamble in the Gobi Desert took the jackpot

Larger than life, Roy Chapman Andrews led a mammoth expedition into Mongolia to seek the Missing Link—and found fossil treasure

On April 21, 1922, an explorer named Roy Chapman Andrews topped the summit of Wanchüan pass outside of Kalgan (today Zhangjiakou), China. Standing at the Great Wall, he gazed out over the western horizon. "Before us lay Mongolia," he wrote later, "a land of painted deserts dancing in mirage; of limitless grassy plains and nameless snow-capped peaks; of untracked forests and roaring streams. . . . The hills swept away in the far-flung graceful lines of a panorama so endless that we seemed to have reached the very summit of the earth."

For Andrews, this moment marked the beginning of one of the most remarkable expeditions in the history of science. In a sense he had reached the summit of the Earth, since what lay ahead—Outer Mongolia and the Gobi Desert—was one of the last scientifically unexplored areas on the globe. The maps he carried showed little more than wavering dotted lines indicating ancient caravan routes (the major ones were missing), vague indications of mountain ranges and a few wrong landmarks and oases.

Escorted by Chinese cavalrymen, the expedition sets out for its 1928 exploration of the Gobi Desert.

The expedition's caravan of motorcars started down the rough, boulder-strewn track into the great Asiatic interior basin that is Mongolia. For the first hundred miles they bumped and slid on a muddy road alongside the rolling, cultivated fields of Inner Mongolia, settled by the Chinese. Slowly the fields gave way to a more arid landscape.

After many miles they passed a small temple, which was deserted. Dozens of soldier's uniforms and monk's robes were scattered about, many of them containing weathered human bones. Well-fed feral dogs slunk among the ruins. The expedition quickly passed by.

Here and there a low escarpment began to interrupt the monotonous horizon. Several expedition members stopped to inspect an outcrop of sedimentary rock while Andrews, in the lead car, continued on. A half-mile west of the tiny settlement of Iren Dabasu, Andrews stopped to make camp at the base of some gray-

Leaving their winter quarters in Kalgan, China, the men return to the rich fossil beds of Mongolia.

The cars worked so well in the desert that traders began using them in place of the traditional camels.

white ridges. He had just finished pitching the tents when the last two cars roared into camp. Andrews hurried to meet them. "I knew that something unusual had happened," he wrote, "because no one said a word. Granger's eyes were smiling and he was puffing violently at his pipe. Silently he dug into his pockets and produced a handful of bone fragments; out of his shirt came a rhinoceros tooth, and the various folds of his upper garments yielded other fossils."

Andrews was stunned and could say nothing. Walter Granger, chief paleontologist of the expedition, stuck out his hand. "Well, Roy," he said. "We've done it. The stuff is here."

It was one of the great moments in paleontology. In 1900, Henry Fairfield Osborn, a paleontologist at the American Museum of Natural History (AMNH) in New York, had proposed a daring new theory about where and how the mammals arose. He predicted that

Expedition leader Roy Chapman Andrews, rifle in hand, may have been inspiration for Indiana Jones.

Central Asia would prove to be the dispersal point for mammalian life on the planet, including human beings. There, he said, is where the Missing Link would be found.

The theory was bold and speculative. Western scientists knew very little about the Central Asian plateau; a rhinoceros tooth, found by a Russian in the 1890s, was the only fossil from the Central Asian plateau ever to be recorded in Western scientific literature.

Twenty years later, Roy Chapman Andrews, then a young curator at AMNH, had lunch with Osborn, by then the president of the museum. At the end of a pleasant meal, Osborn leaned back and lit his pipe. He knew Andrews had something on his mind. "Now let's have it, Roy," he said.

Andrews proceeded to lay out, in detail, his plan for the "biggest land expedition to leave the United States." The purpose: to explore Mongolia and prove Osborn's theory. But it was to be even more than that. "We should try to reconstruct the whole past history of the Central Asian plateau—its geological structure, fossil life, its past climate, and vegetation. We should make collections of its living mammals, birds, fish and reptiles. We should map the unexplored parts and little known regions of the Gobi Desert." The expedition would include a veritable army of scientists, from paleontologists to topographers. They would spend at least five years in the field.

And how did he expect to explore such a vast and forbidding area in only five years, Osborn asked.

By car, Andrews replied. He was convinced that nothing could negotiate the flat, gravelly sands of the Gobi better than a motorcar.

What about gasoline? Osborn asked.

Not a problem, Andrews replied. The expedition would be resupplied by a caravan of 75 camels.

After lunch, an expedition is launched

Osborn fired more questions at Andrews, but the young man had figured everything out. Finally Osborn could think of nothing else. His pipe had gone out and he was leaning forward in his chair, his eyes shining. "Roy," he said, "we've got to do it."

The museum announced the expedition in late 1920. The press seized upon the Missing Link with a vengeance. "In vain," Andrews despaired, "did I try to direct attention to the larger aspects of the work."

Failure—especially the failure to find the Missing Link—was a very real possibility. Many conservative scientists scoffed at the idea that anything of interest would be found there. One suggested Andrews would do just as well to try the Pacific Ocean.

All the hullabaloo in the press resulted in a tidal wave of letters and telegrams directed to the museum;

Everybody got out to push whenever a heavily laden car got stuck in the sand, which was not infrequently. Often they had to unload the car, dig out the wheels and place strips of rope-reinforced canvas in the track.

many of them contained strange proposals or offers of help. ("Regarding search for Missing Link: Ouija Board offers assistance," one cooperative soul telegraphed.) Thousands came from young boys hungry for adventure. "I want to help you find the Missing Link," one, age 14, wrote. "I can climb trees and I don't get dizzy. I know you will meet terrible dangers. Probably wild can-naballs will try to eat you. Who knows, I might even save your life."

On a cold day in March 1921, Andrews departed for Peking (Beijing). Osborn saw him off at the dock. The usually brash and overconfident Andrews was subdued. As they shook hands, Andrews told Osborn that he was afraid of failure, that this would be his swan song in exploration. Osborn put his hand on Andrews' shoulder. "Nonsense, Roy," he said. "The fossils are there, I know they are. Go and find them."

One can understand Andrews' excitement and relief on that day in April 1922 when Walter Granger literally poured fossils out of the folds of his shirt. They had proved there were fossils in Mongolia. The next question was: What kind and how many?

A Santa Fe free-lancer, Douglas J. Preston wrote Dinosaurs in the Attic, *coming out in paperback in January, from which this article was adapted.*

That same evening, while dinner was being cooked, Granger strolled to the base of the cliffs and poked around. Even in the failing light he discovered a second fossil locality and filled his pockets. Before breakfast the next day Charles Berkey, the chief geologist, rushed into camp "acting queerly" and said to Andrews, "Come with me." He led Andrews to the summit of the ridge.

"I saw a great bone," Andrews wrote, "beautifully preserved, outlined in the rock. There was no doubt, it was *dinosaur*."

The Central Asiatic Expedition explored Central Asia and China for eight years, from 1922-30, spending most of the summers in Mongolia and the winters in China. The area they explored was huge: some 2,000 miles long by 1,000 miles wide. Camp life was hard and often dangerous. They were beset by violent windstorms and shot at by bandits and Chinese soldiers; vipers invaded their tents; camels died by the dozen; their cars broke down. When it wasn't burning hot (they once recorded a temperature of 140 degrees F) it was freezing cold and snowing. But for these men, the surreal beauty of Outer Mongolia and the spectacular successes of the expedition dwarfed all misery and hardship. They had struck it rich.

Andrews was deeply affected by the vast open plains

Andrews examines a nestful of dinosaur eggs; their discovery was a sensation back in the United States.

and the endless eroded badlands of Outer Mongolia, the azure skies and brilliant sunsets and star-filled nights. He relished the occasional skirmishes with bandits and recalled with fondness being shot at by Chinese soldiers. His journal conveys the clear impression that what primarily motivated him was not the advancement of science or the discovery of fossils, but a lifelong yearning for adventure and remote, dangerous country. In his heart he was an explorer first and a scientist second.

Because the Central Asiatic Expedition was in so many ways the ultimate expression of Roy Chapman Andrews, it is hard to separate one from the other. The frontispiece of Andrews' book, *Ends of the Earth*, written nine years after that lunch with Osborn in 1920, shows the author sitting on a desert hillock (p. 96). He holds a 6.5mm Mannlicher rifle in his right hand and around his waist wears a loaded cartridge belt into which is tucked (invisible to the camera) his other gun, a revolver. On his feet are dusty leather boots, and the sleeves of his rumpled shirt are casually rolled up. A worn hat, sporting a lone pheasant feather, is perched on his head, with just the right amount of tilt. The man is pictured in profile, his hard, clean jaw slightly elevated, his pale Anglo-Saxon eyes gazing off into the distance. Behind him rises a great eroded escarpment in the heart of the Gobi Desert.

If this description strikes a chord somewhere, there may be a good reason. A persistent rumor has it that Andrews was the real-life model for the film character Indiana Jones (producer George Lucas denies the rumor). Andrews was a man's man. He was a superb polo player and a crack shot. In fact Andrews shot at much of the wildlife he saw and recorded his hunting trips along with the expedition's scientific ventures.

Always making a good story even better

He was also a man of his times, who believed in the general superiority of the Anglo-Saxon peoples and in the absolute superiority of Roy Chapman Andrews. In many ways he behaved as if he were invincible (the title of his second autobiography is *Under a Lucky Star*). He was a marvelous storyteller and never let the facts get in the way of a good tale. (One expedition veteran told me that the "water that was up to our ankles was always up to Roy's neck.")

He had picked an area of the world so disturbed that only the Andrews approach—that of bluff, bravado and drawn guns—would have succeeded, especially considering some of the "difficulties" they had with Mongolian bandits, renegade Chinese soldiers, bureaucrats, Russian spies and, in the final years, with full-scale civil war.

That first year, Andrews planned to reconnoiter Outer Mongolia and the Gobi and look for promising sites, which would then be excavated at length in following years. As they pushed deeper into the wastes of the Gobi, the fossil discoveries came thick and fast. It was utterly virgin territory, and rare and important fossils were packed away by the gross. Some valleys seemed *paved* with fossils. Once they discovered a Buddhist *obo*, or shrine, built entirely from gigantic fossil bones of a long-extinct rhinoceroslike animal. Andrews was usually in the lead car with J. B. (Shack) Shackelford, the photographer, and a Mongol interpreter, scouting out their course. They tried to follow ancient caravan trails and old trade routes, because over the centuries the flat pads of camel feet had beaten down a perfect road. The rest of the expedition would fan out. Granger and his assistants stopped to explore interesting outcrops. The geologists and archaeologists and others also stopped and poked around. Often they broke up into smaller exploring parties, enabling them to cover more territory, and were separated for weeks.

On September 1, 1922, six hundred miles from Kalgan as the crow flies and about 2,000 miles by car, the expedition arrived at Shabarakh Usu, a small oasis in the foothills of the southern Altai mountains. As

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usual, Andrews' car was far in advance of the others and, as they approached Shabarakh Usu, Andrews spied a group of Mongolian yurts (felt huts) at some distance off the trail.

While he went to talk to the Mongols about possible old caravan routes northward, Shackelford left to explore a pile of rocks near the trail—and suddenly found himself standing on the top of an escarpment, looking down into a vast basin, a "chaos of ravines and gullies cut deep into red sandstone." It was a fantastic, alien landscape. He climbed down one ravine and there, in front of him, was an eroded spire of soft sandstone with a white fossil skull balanced on the top, "ready to be plucked off" like a rare fruit. Shackelford carried it back to the car. "Obviously reptilian," Andrews wrote, "but unlike any with which [Granger] was familiar. All of us were puzzled."

Andrews reconnoitered the rim of the escarpment. "Cretaceous and very rich in fossils," he concluded, marking it down for future work. As the sun set, the formations blazed such a brilliant red that the men christened them the Flaming Cliffs.

This skull was the first fossil discovery at what turned out to be one of the richest localities anywhere in the world. (The skull, when returned to New York for study, proved to be a new species of dinosaur, which was later named for the expedition's leader: *Protoceratops andrewsi.)*

The next year, 1923, Andrews decided to spend a good chunk of time at Shabarakh Usu. The team arrived in early July and in a week had made a discovery that caused everyone—including the press back home—to forget all about the Missing Link. On July 13, one of the young paleontologists, George Olsen, reported

Skull of a *Protoceratops andrewsi* is partly excavated at Shabarakh Usu. Species was named for the leader.

George Olsen (right) and an assistant nicknamed Buckshot uncover leg of a carnivorous dinosaur.

at lunch that he had found some large fossil eggs (p. 98). "Inasmuch as the deposit was obviously Cretaceous," Andrews wrote, "and too early for large birds, we did not take his story very seriously. We felt quite certain that his so-called eggs would prove to be sandstone concretions or some other geological phenomena." Nevertheless, after lunch they decided to go with him and inspect the "eggs."

"We saw," wrote Andrews, "a small sandstone ledge, beside which were lying three eggs partly broken. The brown striated eggshell was so egglike that there could be no mistake." Immediately they launched into a heated discussion. Were they really eggs? What animal could possibly have laid them? Could these be *dinosaur* eggs?

"But finally we had to admit," Andrews said, "that 'eggs are eggs' and that we could make them out to be nothing else. It was evident that dinosaurs did lay eggs and that we had discovered the first specimens known to science."

Many other eggs appeared to be enclosed in the sandstone. Olsen began brushing away the loose sediment from the top of the ledge and uncovered the second surprise: the skeleton of a small, toothless dinosaur. The predator, which had apparently been buried in the very act of stealing the eggs out of the nest, was yet another new species. Andrews believed that its presence was as conclusive a proof of the age of the eggs as one could hope for.

Rather than excavating the eggs at once, Granger cut a large block of stone out of the ledge, encased it in plaster and packed it in a box lined with camel's hair. (This hair, pulled off their shedding animals, proved to be a marvelous packing material for delicate

INDULGENT. THE SENSE OF REMY.

fossils. The only problem was that if a camel was stripped of his hair too quickly, he would develop a bad cold and "whimper in the most disconsolate way, while great tears ran out of his eyes.") The block was eventually shipped back to the museum, where technicians carefully chipped away the sandstone matrix, exposing a baker's dozen of oblong eggs, arranged in two concentric circles just as the dinosaur had laid them 75 million years ago.

A discovery takes the country by storm

While the expedition members knew that this was an important discovery, they could hardly predict the stir it would cause back in the United States. The public went wild over dinosaur eggs, which promptly became as much of a problem as the earlier emphasis on the Missing Link. The eggs became so hot that actor John Barrymore, among many others, pleaded with Andrews for—and was given—just a few bits of broken shell. William Randolph Hearst offered Andrews $250,000 outright for an exclusive story on the eggs and the rest of their discoveries.

While everyone was frantically searching for dinosaur eggs at the Flaming Cliffs, Granger picked up a small piece of sandstone and cracked it open. Inside was a tiny skull, which he labeled "unidentified reptile." When a paleontologist studied the specimen at the museum a year later, he was flabbergasted: the unidentified reptile was none other than a mammal that lived during the Age of Reptiles. The museum sent a frantic letter to Urga (Ulan Bator), which reached the expedition in 1925. "Do your utmost to get some other skulls," it ordered.

Upon receipt of the letter Granger returned to the base of the Flaming Cliffs, where he picked up a likely-looking nodule and cracked it open. Inside was another fabulously rare skull! Later that summer everyone was put to work examining the sandstone nodules that littered the basin floor, cracking them open by the thousands under the scorching sun. It was hideous work, but in a week they had discovered seven more skulls. "It was possibly the most valuable seven days of work in the whole history of paleontology up to date," Andrews wrote.

When the skulls were studied at the museum the following year, they proved to represent five genera of mammals. For the first time, scientists knew with certainty that many kinds of mammals had lived in the Age of Reptiles. In the furor over the dinosaur eggs, this news was virtually ignored in the popular press. (Scientists recognized the importance of the discovery immediately. Some suggested it solved the mystery of why the dinosaurs had become extinct: the small mammals ate their eggs.)

The expedition's supply camels are led across the desolate dunes of Tsagan Nor in a search for water.

At Urtyn Obo, explorers set up camp in 1928; wooden crates carried gasoline going out and fossils back.

Andrews dreaded more than anything else the savage sandstorms that swept down from the Siberian steppes. Sometimes they would blow for days, filling the air with choking sand and flying gravel. Occasionally during those times, all that the men could do was crouch in the tents with wet cloths over their faces.

Andrews described one such storm that descended upon them at the Flaming Cliffs shortly after the discovery of the mammal skulls. The first inkling of the storm came just before dawn. Andrews suddenly awoke "with a strange feeling of unrest vibrating every nerve." He buckled on his revolver and quietly circled the camp. Everything lay in a tomblike stillness. Puzzled, he crawled back into his sleeping bag but could not sleep.

"At the end of fifteen minutes," Andrews wrote, "I slowly became conscious that the air was vibrating to a continuous even roar, which was getting louder each second." An enormous "wind-devil" was descending upon them. It struck with a blast and was gone.

The worst was yet to come. When they arose that morning, "in the gray light of dawn we could see an ominous bronze cloud hanging over the rim of the basin." Ten minutes later the main storm struck, "like the burst of a high-explosive shell. Even with my head covered I heard the rip and crash of falling tents. . . . As our tent swept away, he [Granger] had leapt to save the six tiny fossil Cretaceous mammal skulls." The sand and gravel actually tore the pajamas right off Andrews' back, lashing his skin until it bled. By the time the gale subsided, the camp was devastated. Chairs and tables had been smashed, while tents and clothing had been shredded and scattered along a half-mile strip downwind from the camp. "Had our cars not been facing the wind," Andrews wrote, "they certainly would have been overturned." As it was, the windshields were so sandblasted that they had to be knocked out before the cars could be driven.

Dogs with a taste for human flesh

Wherever the expedition members encountered good grazing and water, they usually ran into a small group of nomadic Mongols. At first the Mongols were utterly terrified when the motor caravan approached, sometimes fleeing into the mountains (one woman became so frightened she had convulsions). Most had not seen a white man or a car before. The travelers were equally terrified of the Mongol dogs, which would rush the expedition in vicious, snarling packs. (Since the Mongols did not customarily bury their dead, the dogs had developed a taste for human flesh.)

Most dangerous of all were the bandits that roamed the countryside where the trade routes converged on Kalgan, robbing caravans and murdering traders.

Merin, a Mongol chief and leader of the caravan, admires his picture in an Andrews magazine article.

These bandits had to be faced every time the expedition departed and returned to Kalgan.

The members were always heavily armed, even to the point of carrying along a machine gun for a while. Although the traders were terrified of bandits and tried to avoid them whenever possible, Andrews relished a good fight. One incident in particular illustrates the Andrews method. He was driving alone one day along a caravan trail near Kalgan. "I saw the sunflash of a gun barrel on the summit of a hill three hundred yards away," he wrote. "The head and shoulders of a single mounted horseman were just visible against the sky." The man appeared to be signaling to someone on the far side of the divide.

Without a second thought, Andrews drew his revolver and fired two shots to frighten the man, "whoever he might be." Moments later his car topped the rise, and sure enough, blocking the dirt track were three mounted brigands, quickly unshipping their rifles from their backs. Waving his drawn gun and yelling at the top of his lungs, Andrews floored the accelerator and the car roared down the slope directly at the men. The Mongol horses, which had probably never seen a car, began bucking and rearing with fright. "In a second the situation had changed!" Andrews wrote. "The only thing the brigands wanted to do was to get away, and they fled in panic. When I last saw them they were breaking all speed records on the other side of the valley." The only time an expedition member was actually wounded was when Andrews shot himself in the leg with his own revolver. One can imagine his embarrassment.

Neither bandits nor storms, nor snakes nor sand finally defeated the expedition. It was ended by bureaucrats. Outer Mongolia came increasingly under Soviet control during the eight-year life of the expedition, while China became embroiled in a series of bloody civil wars. From 1925 on, the expedition was thoroughly investigated and harassed by the Soviet secret police. In Urga, spies followed the members wherever they went. (One hapless spy wasn't given a car and ran himself ragged trying to shadow them. Finally, Andrews took pity on the poor fellow and invited him to ride in his car.) At one point the expedition was required to take two "scientists" along. One of them, a fellow named John Dimschikoff, reported that Andrews was plotting with the United States and Great Britain to annex Mongolia. The other spy contradicted this absurd claim and Dimschikoff was promptly sent to Siberia.

In 1928 the expedition's collections were seized by the Chinese in Kalgan, and the members were accused of exploring for oil and minerals, and of smuggling opium, among other things. Six weeks of negotiations and considerable "squeeze" (bribes) were required to release the materials. By 1930, the situation in Mongolia and China had become extremely dangerous for foreigners, and the museum called Andrews home.

For thousands of years, great caravans loaded with silks and ivory, furs and spices had been crossing the Gobi Desert. The expedition itself encountered one of these great caravans on the Great Mongolian Road to Chinese Turkestan. It was stopped on a plain, a big blue tent surrounded by 200 camels. It would take the caravan nine months to cross the Gobi, in a pattern of trade that had existed for millennia.

A desert way of life comes to an end

Andrews realized all this would change. Railroads and cars would replace the ancient caravans. "The romance and glamour of the desert will be destroyed," he lamented. "Tourists will sit in heated cars, eating the food of Europe, reading week-old newspapers, and comprehending not at all the glorious history, the tragedy and the romance of the Gobi trails."

What took a caravan nine months took Andrews a little more than seven days. In one fell swoop he had proved the Gobi accessible to motor vehicles and had thrown open the strongholds of the nomadic Mongols, those proud descendants of Genghis Khan. The very thing that Andrews feared, he himself created. When he returned to Kalgan after the first summer of exploration, he was besieged by traders wondering how the cars had fared in the desert. Within three years, a hundred cars were running where not one had gone before. The ancient Mongolian way of life was changed forever.

The expedition returned to tremendous acclaim. Osborn considered his theory on the origin and dispersal of mammals to have been proved. (There was little mention of their failure to find the Missing Link. Today we believe that Man evolved in Africa, not Asia.) For Andrews, however, the expedition did turn out to be his swan song in exploration. In 1934, he accepted an appointment as director of the American Museum of Natural History, a desk job which proved to be a disaster. The museum was badly hit by the Depression: salaries were cut, publications curtailed and some jobs eliminated outright. No museum funds were available for fieldwork or expeditions. The job would have been difficult for anyone, but on top of everything else the Andrews style—appropriate for fighting bandits in Mongolia—did not sit well with the trustees. In 1941 he was asked to resign.

Andrews spent the rest of his life writing about his adventures. His death in 1960, in Carmel, California, was not even noted in the museum's annual report. An old man of 76, he had mostly been forgotten. But his legacy lives on in the rich collections of the American Museum, which have done so much to help piece together the story of life on this planet.

Andrews and topographer W. P. T. Hill (right) survey the badlands—and rich fossil beds—around Urtyn Obo. Existing maps proved useless, and they needed to map the sites and the underlying geology of their finds.

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German engineering. The Volkswagen way.

Adrian Fisher exults in the middle of a hedge maze at Hever Castle where, it is said, Henry VIII courted Anne Boleyn. Fisher's contagious enthusiasm for mazes has sparked new interest throughout England.

By Richard Wolkomir

It is easy to get bushed when you're threading a maze

If being lost is your idea of having fun, you will understand why maze running has become a national pastime in Britain and Japan

Brick pathways trace intricate design of the Tudor Rose maze, built in 1985 at restored Kentwell Hall.

At Hampton Court, the sprawling palace Cardinal Wolsey built near London in 1514, a tourist from the United States recently discovered that strolling through a maze is an un-American activity. Americans like getting to the point, cutting corners, taking the straight-line approach. But the pathways of the maze in the garden at Hampton Court twist diabolically between six-foot hedges of privet and yew (p. 118). Once inside, you can't see a way to escape. After spending an hour in there, the desperate American finally found a gardener's broom and held it over his head so friends on the outside could guide him to the exit. Ian Burgess, the maze's puckish ticket vendor, was unconcerned. "Usually we just send someone through at the end of each season to clear away the skeletons," he said.

Mention mazes and most Americans think of psychologists, mice and rats. But threading king-size mazes for amusement has been a British pastime since the Dark Ages, and today this curious sport is enjoying something of a renaissance at parks and estates all over the Sceptered Isle. Last year, more than a quarter-million visitors navigated the venerable Hampton Court maze. Longleat estate, near Bath, installed one of the world's largest mazes in 1978, and on a holiday more than 3,000 people are apt to wander its 1.5 acres of hedge-bordered paths linked by wooden bridges (p. 110). To show how bullish the population is on this form of recreation, the British Tourist Authority has tentatively designated 1991 the "year of the maze."

Britain has more mazes open to the public—nearly 60, at last count—than any other country except Japan. It is estimated that at least 100 commercial labyrinths have popped up at Japanese amusement complexes in recent years. On a typical weekend, upward of 5,000 enthusiasts a day may spend 500 yen apiece (half the price of a movie in Japan) for the fun of running through one of them. Japan's maze craze reflects a need that goes beyond the desire for mere diversion, according to one facility director. "Most of the time, people in our society are deprived of the chance to make their own decisions," she says. "In a maze, you *can* make your own decisions—and go for it."

Japanese mazes are made of wood, not hedges, and many of them are designed by Stuart Landsborough, an Englishman who moved to New Zealand 17 years ago and began putting his "puzzles" together shortly thereafter (see page 114). A similarly offbeat operation, Minotaur Designs, is responsible for most of the newfangled mazes now being built in Britain and Europe (and one soon to be built in South Korea). The twist-

Photographs by Bryan and Cherry Alexander

Gardener trims bushes of a complex maze at Longleat House; it has six wooden bridges with underpasses.

ing paths of some Minotaur creations feature contemporary symbols drawn from such disparate worlds as science and rock 'n' roll, but all of the firm's mazes are rooted in the past—in the mysterious "turf mazes" of the Middle Ages, in the decorative mazes of Renaissance gardens and in Victorian hedge mazes.

Each Minotaur maze is a unique work of art and a challenging form of entertainment. "Mazes are play, but you can't toy with a maze as you can with a computer game because you're in it," says one of Minotaur's three partners, Adrian Fisher, a peppy 36-year-old graphics expert, inventor and business consultant. "A maze is a game of chess between the designer and the public."

Minotaur began when a maze-building lord noticed a newspaper article by Fisher and sent it to his friend, another maze zealot, Randoll Coate. After graduating from Oxford, Coate attended an art college in London, only to have his studies there interrupted by World War II. Following the war he accepted a post in the diplomatic corps, serving in Argentina and Italy. Now retired, he has become an artist after all. At college, Coate was fascinated with mazes. When Fisher met him, he was helping estate owners turn their ancestors' plans into reality. "If you're the owner of a stately home in Britain, you probably have on your wall an enlarged plan of your estate," he says. "If it's old enough, it will include a formal garden, a bowling green and a maze, which may have been designed but was never finished, or perhaps did get built but was then abandoned."

Coate and Fisher pooled their skills and launched Minotaur Designs in 1979. They met Graham Burgess, a slender, bearded landscaper, through mutual friends and he joined them in 1983. Minotaur's three associates operate independently, calling upon one another's special skills as needed. "Actually, we're so loose-knit we're less an organization than a disorganization," says Fisher.

For the nobility, an excellent investment

As Minotaur's businessman, it is Fisher who spreads the gospel, persuading landowners that a maze is the very thing they have been yearning to build. "Mazes are an excellent investment for any lord opening the family castle to the public because they attract people and quickly earn back their construction and design costs," he noted during a recent interview at his computer-jammed office in St. Albans. "Symbolism is not a luxury," he added, referring to any Minotaur maze's central feature, the images incorporated in the design of the paths. "It's essential to successful marketing and it costs no more to plant a maze in the shape of a unicorn or a dragon."

Archbishop's maze at Greys Court resembles the classical labyrinth in Chartres Cathedral. It features a sundial at the center, mounted on a base consisting of two crosses—one Byzantine, the other Roman.

Like his associates, Fisher is a perfectionist. When he showed a visitor a maze in a park near London's Warren Street, a trash bin caught his eye. "Disgusting," he murmured, dragging the barrel off the bricks that formed the maze's paths. He regarded the maze critically. It was not built by Minotaur. "The designer based it loosely on the maze in Chartres Cathedral, but he didn't have enough room for the 11 rings at Chartres so he had to lop off two rings—absolutely barbaric!" Fisher stormed. "The balance is off!"

Minotaur's own mazes involve long discussions with the client (whom Fisher refers to as the "patron") about the site, the maze's size, whether to create it from hedges, brick or other materials, and the symbols to be introduced into the pathways. Coate, working in his London home, draws a picture of the maze, incorporating various images in its lines. The work is painstakingly detailed. It took the designer two years to plan a maze shaped like a human footprint for his brother-in-law's country home. The scheme features more than 100 images of local creatures, including a pig, a ginger cat, a hatching chick and a kingfisher.

After getting hopelessly bogged down in the mazes of England, Richard Wolkomir had no trouble discovering the way back to his home in Vermont.

Each Minotaur maze, like those of ancient Crete, is symmetrical—but not absolutely symmetrical. It's possible, in a traditional maze having one entrance, one exit and no detached walls, to get out by placing a hand against either wall and then following it all the way to the exit. That trick doesn't work in a Minotaur maze. "We devise pathways that take you in the most exhaustive way to the center and back," Coate says.

Coate's strength is working out the overall design of mazes and Fisher's is devising the intricate networks of pathways that constitute the puzzles, but each man is proficient at both. Graham Burgess transforms their schemes into reality. At his nursery office in the Hampshire village of Whitchurch, beside the ponds where he raises the water lilies for which he is renowned, Burgess uses a computer program devised by Fisher to produce an initial cost estimate. As he punches the keys on the console, a maze configuration appears on the screen. Underneath it are blanks where he can fill in the maze's specifics. He calls for a maze

Maze at Beazer Gardens in Bath surrounds mosaic likeness of Gorgon's head made with chips of marble.

planted with yew hedges, three feet high at installation. He stipulates gravel paths six feet wide. He also punches in the width of the hedges, the distance between plantings (and hence the number of bushes), the cost per bush and other vital information. The computer whirrs momentarily, then presents the price estimate in pounds sterling—in this case, it is the equivalent of $60,000. "We can fiddle with that and adjust the price by adjusting the specifications," says Burgess. "For instance, we could substitute a cheap alternative to the yew hedges, like beech."

Every one of Minotaur's mazes is unique. At Newquay Zoo, in Cornwall, Minotaur created a dragon-shaped maze. After entering through the dragon's tail, you wind through the creature's entrails, formed from hedge-lined paths, where you find ten sculpted beasts of 50 million years hence—zoologists' extrapolations of evolution's future. Then, if you can find the way, you exit through the mouth.

Nearby, at the East Wheal Rose Mine, the Lappa Valley Railway maze honors Richard Trevithick, who built the world's first railway locomotive there in 1804. The maze's brick-on-grass paths trace the shape of that original engine, complete with flywheel and cogs. Embodied in the paths' turns are the date 1804 in Roman numerals and E.W.R., for East Wheal Rose Mine.

At Beazer Gardens in Bath, the Georgian resort built on the site of an old Roman spa, Minotaur has created an elliptical maze with stone pathways (left). The "goal" at the center is a large mosaic of the famous Gorgon's head of Bath, made with 92,000 marble tesserae imported from the Vatican quarries in Italy. Modeled on a Roman carving, the Gorgon's head is encircled by mosaic images celebrating Bath's Celtic and Roman history, including dolphins, wild boars, Orpheus and Pegasus.

Braille pathways for the blind

Still in the design stage is an unusual maze Coate conceived to honor an acquaintance, the late Argentinian author Jorge Luis Borges. It consists of two hourglasses—a full one symbolizing Borges' birth and an empty one representing the moment of his death. Borges, though blind, was fascinated with labyrinths, and Coate's plan calls for marking all of the maze's pathways in Braille. The author's literary executors have discussed the possibility of installing the maze in Argentina as a memorial.

Some Minotaur projects reflect a more traditional English style. For instance, after restoring 450-year-old Kentwell Hall at Long Melford in Suffolk, London attorney Patrick Phillips and his wife, Judith, asked Minotaur to design a maze for the vast courtyard (p. 109). "A brick maze was not typical of a Tudor house like this, but it certainly was *possible*," Judith Phillips recently told a Kentwell Hall visitor.

That afternoon, Kentwell was thronged with townspeople dressed as Elizabethans for the Phillipses' annual Tudor Reenactment. For three weeks, the manor would return to the 1500s, which involves everything from cooking on the Tudor hearths to using correct period locution. Outside, Fisher explained the design of the red, brown, cream and orange brick maze which fills the courtyard between the mansion's wings and its surrounding moat. "It's shaped like a rose, symbol of the House of Tudor, with five thorns and five petals, for the five Tudor monarchs," he said. "That's a giant chessboard at the center, and I once played a game on it for a television show."

Three Elizabethan maids in floor-length gowns and floppy hats walked along the brick pathways, oblivious to the maze's 15 diamond designs. "The diamonds contain sketches of images associated with the Tudor period," Fisher explained, adding that construction of the maze had overlapped a reenactment. "The bricklayers had to wear Tudor costumes," he recalled.

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'You have to remember: mazes in Japan are not like mazes in England'

A visit to Shiga Ritto, one of the newest and largest mazes in Japan, began with enthusiastic greetings. "Irasshaimase, irasshaimase," several young women chirped as we arrived at the gate. "Welcome, welcome." They waved us up the hill to the rustic brick courtyard with its trestle picnic tables and benches. Several log cabins —a snack shop, a gift shop, an office—and two totem poles completed the supposedly Canadian scene. Children were shouting and playing, parents were calling, hundreds of people were milling about, drinking, eating ice cream, wandering through the gift shop. The loudspeaker blared without letup: "Before you start, don't forget to go to the bathroom." "Please don't climb the walls." "Is there anybody who wants to be saved? Please wave one of the red flags and we will lead you out." Stuart Landsborough, my companion and ostensible guide, tried to talk over the noise. "You have to remember," he shouted, "mazes in Japan are not like mazes in England."

A blond, blue-eyed Englishman who lives and works in New Zealand, Landsborough is a major force behind Japan's current obsession with mazes. He's the designer of Shiga Ritto and 20 other complexes franchised by an Osaka-based company, Maze Products, which plans to have about 5 more open by next summer. "An English hedge maze is artistic and ornamental," Landsborough told me. "Here in Japan we're aiming at amusement. Our mazes are designed to accommodate masses of people—as many as a thousand enthusiasts at a time."

The construction of Japanese mazes is basically uniform: plank walls 6½ feet high; corridors about 6 feet wide; macadam floors; perhaps 2,000 yards of pathways; and four checkpoints. The route of a maze can be altered by just shifting a wall or sliding a door. To keep things interesting, an owner usually changes the course once a week or so.

Typically it takes about 50 minutes to get through a maze like Shiga Ritto, which is located in Kurita, a town in Shiga Prefecture. Some customers wander around for hours, however, and Landsborough

Robert Wallis

Seeking out checkpoints, maze runners scurry intensely through walled pathways.

likes to tell a joke about the honeymoon couple who went into one of his labyrinths and came out with two children. "Some people say that the view from one of the bridges in a maze helps them figure the way out, but often bridges are designed to mislead," he said. I asked him if he remembers his own designs. "I can't even figure them out when I'm in them," he replied. He wasn't kidding.

We embarked shortly before noon on what I thought would be a brief stroll around the 1,400-yard course. I could see four towers topped by the letters M, A, Z and E. We were supposed to get our tickets stamped in a machine at each of those checkpoints. "The checkpoints create interest," Landsborough explained. "If you manage to get out of the maze but haven't gotten the stamps, you haven't solved the puzzle."

We headed for the M, walking fast. We kept finding ourselves staring at the M stamp machine, either from a bridge or from the wrong side of the exit turnstile. After 30 minutes we still couldn't get to M from the right side, although we had come close. "Just because we're near doesn't mean we're near," said Landsborough, which was not exactly what I wanted to hear.

It was hot. I was leading and Landsborough was directing me from behind, saying: "Let's try that way. No, maybe that way. Let's go up this bridge and look over and maybe we can get our bearings. That looks like the right path. Oops—dead end." I was becoming increasingly frustrated. I had another appointment in two hours.

A young woman approached carrying a red pennant with "Help" written on it. She was an official rescuer, leading an assortment of failures: one tired woman, two children who wanted to go to the bathroom and a couple who were arguing about whether to follow her even as they followed her. I considered joining them. Landsborough also seemed less than enthusiastic about continuing. But I looked at my empty card, at the M emblazoned against the blue sky, at the hundreds of determined people milling about. "Maybe we should try a little longer," I said. "I think it's this way," he said. Off we went and I knew I was hooked. I was not going to leave without the full complement of stamps, even if it took me all day.

Five minutes later we reached the turnstile that led to M and, as I slid my card into the machine, I let out a whoop. I actually felt a sense of achievement—or at least relief. Others were finding relief in other ways. A mother and two children giggled from the opposite side of the fence as they slipped their cards through, asking people to stamp them, please. Clearly Landsborough did not approve. "Those who cheat are only cheating themselves," he observed.

After M we were on a roll, finding Z and E within ten minutes. Then nothing. Once again I considered giving up, but, ratlike, we scurried on, trying not to repeat our mistakes. Finally we hit A. Another whoop. Now for the mad dash out. I still had time to make my appointment. However, getting to the exit was worse. Although we could see from a bridge that the route led along the outside of the maze, we couldn't get to it and kept going in circles, winding up in the interior or on another bridge—or worse, back at M. But all good things must come to an end and we finally found the outside path, along with a hundred others, and joined the happy procession thronging to the finish line. Total elapsed time: 1 hour 20 minutes—with the expert. I phoned ahead to my next appointment, another maze, and canceled.

Carol Simons

Jeremy Bridges-Bromley, age 8, wearing a jarringly un-Tudor blue running suit, enthusiastically hopped and skipped along the maze's pathways. The sun abruptly came out for one of its momentary British appearances and the drizzle-wet bricks of the maze shone, while a peacock on the moat's wall spread its iridescent tail and screamed. Jeremy stopped in mid-skip and exclaimed: "This maze is a-*mazing*!"

One amazing feature of Minotaur mazes is the plethora of images and symbols the designers pack into the pathways' curves, sometimes imposing one image atop another, and those two atop a third. At Leeds Castle, for instance, Minotaur designed a maze that mirrors the onetime royal residence itself, with castellated yew hedges forming the towers and bastions. The entrance is by bridge over a dry moat; to gain the exit, you go underground through a grotto encrusted with crystals, then deeper still to a hermit's niche and, finally, out through a secret passageway. The center is a turret, from which visitors can look out over symbols that are hidden in the convolutions of the hedges. One symbol is a queen's crown, since Leeds Castle descended through the female line. Another is a chalice, for the daily masses sung in the castle's chapel for Queen Eleanor after her death in 1290.

Why squeeze so much into a maze when 95 percent of the people will never see it? "You could ask the same thing about St. Paul's Cathedral," Fisher says. "It's full of architectural refinements that most people will never notice. What matters is the pursuit of excellence." Adds Randoll Coate: "Not being able to see symbols while you're walking the maze is a great advantage, because it maintains the esoteric, secretive quality that always has clung to labyrinths."

The mysterious origin of the maze

The most mysterious thing about mazes is their origin. All that has come down from antiquity is the myth from which Minotaur Designs took its name. The sea god Poseidon, so the ancient tale goes, punished King Minos of Crete for a transgression by inducing his queen to mate with a sacred bull. She gave birth to the Minotaur, half-human, half-beast. To pen the dangerous creature, Daedalus, who served the king as an architect and inventor, built the labyrinth: a complex of turning passages seeming to have no beginning or end. The word "labyrinth" may come from *labrys*, a Minoan double-headed ceremonial axe.

In 1822 B.C., the Egyptian pharaoh Amenemhet III began building a labyrinth with 3,000 rooms and a forest of pillars. It was to be his funerary temple. In Crete, no labyrinth ruins have ever turned up, although the Cretans did begin inscribing labyrinths on their coins around 400 B.C. "All of the ancient laby-

In his London flat, retired diplomat Randoll Coate studies several of the symbolic mazes he has designed.

Landscape artist Graham Burgess, who turns maze plans into reality, inspects lilies growing in his pond.

rinths were unicursal, meaning they had only one path that wound this way and that until it finally arrived at the center," says maze expert Jeff Saward. "You couldn't get lost in one of them." An industrial chemist with long blond hair, a beard and alert blue eyes, Saward heads the Caerdroia Project, an association of maze enthusiasts based at his home in Thundersley, Essex, which has the Cretan maze design painted on its red front door. Caerdroia is Welsh for City of Troy, a name for ancient mazes and an allusion to the almost impenetrable walls of the legendary city. Saward spends most of his spare time tracking down mazes, organizing meetings and publishing a journal. But although he and other experts know how the oldest labyrinths were built, they can only speculate about their significance.

The Roman empire was peppered with mosaic versions of the labyrinth. In the Dark Ages, Scandinavians made mazes with stones outlining the paths. Similar turf mazes were dug into meadows throughout Europe. Using old records, the Caerdroia Project has identified the sites of 110 turf mazes in Britain. Eight are still in existence, including one hidden in a Hampshire woods near Breamore House, an Elizabethan manor (p. 119). Close to the manor is a Saxon church, built around A.D. 1000, that may be connected with the maze. John Stimson, Breamore's gardener, cites a local legend. "Centuries ago, there was a monastery here, and the monks built the maze as a penance—at least, that's what people say," he reports, shrugging.

A footpath from Breamore winds through 1,000 acres of huge sycamores and yews festooned with ivy. Stoats dart across the path into the bluebells under the trees. The path crosses fields where hedgerows march to the horizon, with cows and thatched-roof stone farmhouses in the distance. It climbs a hill, enters a copse and stops at the maze. The maze, which is round, covers an area about the size of a tennis court. Its path is a grassy spiral, bordered by ditches. In late summer, buttercups, thistles and dandelions grow in the ditches. At the center is a mound. On one recent day, some unknown visitor had laid upon the mound a spray of wildflowers.

Despite stories about religious connections, Jeff Saward theorizes that ancient mazes were actually used for ceremonial pagan dances. "If you run one on

Groundskeeper mows grass between brick pathways of maze at the Breamore Countryside Museum. Built in 1984, the Great British Maze measures 52 feet on each side and includes four confusing wooden gates.

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Youngster points way through hedges at Hampton Court Palace maze, built about three centuries ago.

a clear, frosty morning, you speed up, slow for turns, speed up again," he says. "The first three turns take you almost to the center, then out, the loops getting bigger so you run faster, and then you're at the center and you stop. It's disorienting and maybe that helped set a meditative mood."

By medieval times, turf mazes were a fixture at fairs. Young men would run them, the winners receiving a keg of beer. Meanwhile, at Chartres and other great cathedrals of Europe, the builders sometimes created mazes in the floors, which, so the theory goes, pilgrims navigated on their knees. During the Renaissance, garden mazes came into vogue, decorative plantings marking the pathways where ladies and gentlemen might flirt. By Tudor times, such mazes had become standard on large British estates. Over the centuries the tradition waned, but in the Victorian era it reasserted itself in the form of puzzle mazes made of high hedges at parks and public gardens to amuse citizens on their holidays. After that, enthusiasm waned again, but mazes remained very much a part of the British scene.

In 1950, for instance, the Rev. Harry S. Cheales, parish rector in the Cotswold Hills village of Wyck Rissington, dreamed that a tall figure directed him to build a maze in the rectory garden. Cheales planted 5,000 willows representing the pilgrim's path through life. The path ended at a large redwood tree, which stood for paradise. Each year on the day of the church's patron saint, Cheales led his parishioners through the maze. In 1980, after the clergyman retired, the maze was bulldozed.

Mazes often vanish. Recently, driving in Henley-On-Thames, Adrian Fisher braked near an estate and dashed into the trees, where a bulldozer stood beside some uprooted hedges. "This was a maze in a garden that was once part of Friar Park, where George Harrison, the Beatle, now lives," Fisher said, adding mournfully, "they've dug it up for a housing project."

Despite the occasional loss, Britain's mania for mazes is once again clearly on the rise, and in more ways than one. The maze at Leeds Castle, for example, features elevated pathways crossing over other pathways like a tangled freeway network. At Lord Peregrine Eliot's Cornwall estate, yet another dimension comes into play: time. The maze there has movable gates that are opened and closed at odd moments. "People go absolutely mad," says Randoll Coate.

Mathematicians have devised complicated formulas for outwitting the maze makers, but dogs seem equipped to solve such problems without the benefit of any assistance whatsoever. Not long ago the producers of a BBC-TV program staged an interspecies contest in the maze at Longleat, which encloses 1.5 miles of hedges, bridges and a tower. With a brown-and-white mongrel named Buffa on a leash, a correspondent plodded the trail for an hour and a half before reaching the central tower. Then the test began in earnest. The man tied a red balloon to himself so the cameras could follow his progress en route to the exit. He tied a white balloon to Buffa and unleashed her. While the red balloon bobbed aimlessly among the pathways, Buffa's white balloon shot arrowlike along the paths directly to the gate. Finding the way out took her only four minutes. Meanwhile, the puffing correspondent wandered about inside, hopelessly lost. Finally the camera crew sent Buffa back into the labyrinth wearing a coat that read "Rescue Dog." It took her only a few minutes to locate the poor fellow and lead him out.

Its origins unknown, concentric turf maze nestles like a medieval jewel in the woods on Breamore Down.

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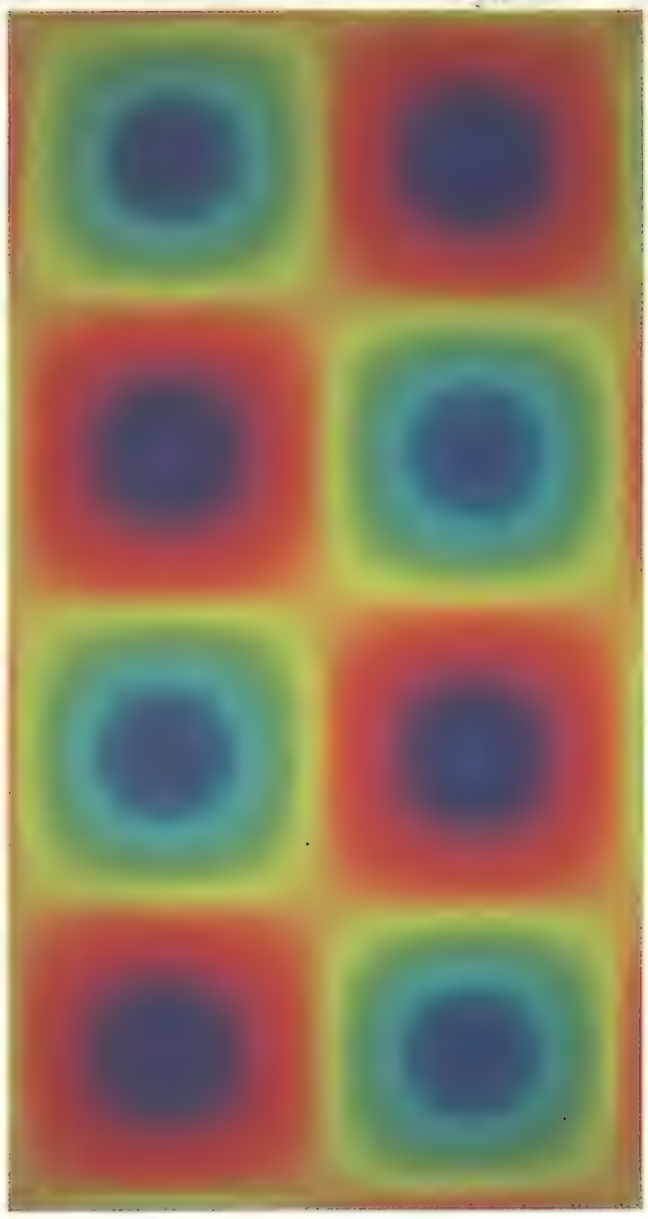


Mixing three paint colors may appear disorderly, but unseen patterns become apparent in computer models of process, based on mathematics of chaos. From left, three stages in mixing are paired with their models.

By James Gleick

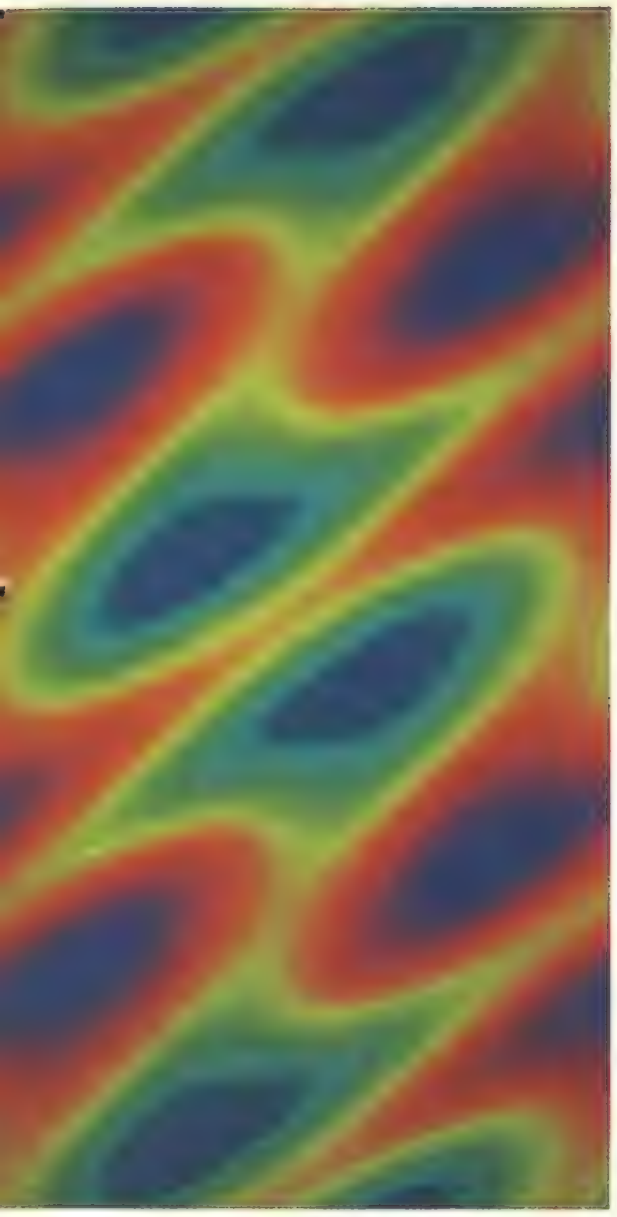
New images of chaos that are stirring a science revolution

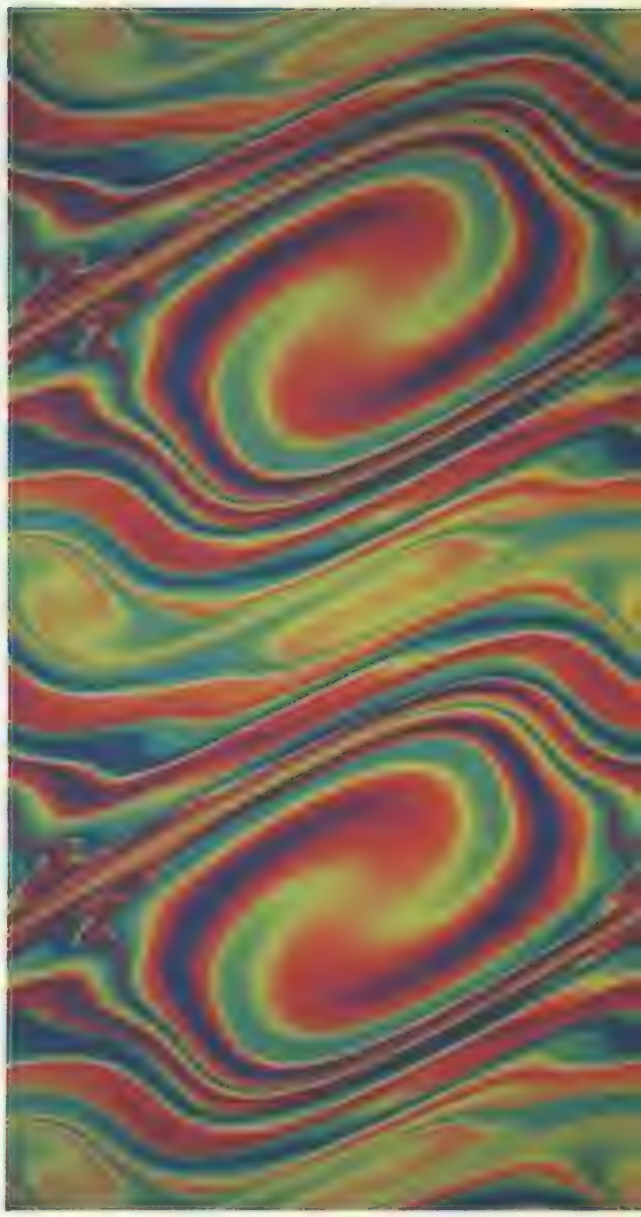
A special breed of researchers, armed with complex equations and computer graphics, saw patterns where others saw only disorder

Santa Cruz was the newest campus in the University of California system, carved into storybook scenery an hour south of San Francisco, and people sometimes said that it looked more like a national forest than a college. The buildings were nestled among redwoods, and, in the spirit of the 1960s, the planners endeavored to leave every tree standing.

Like other graduate departments, the physics department had to create itself from scratch, beginning with a faculty of about 15 physicists, energetic and mostly young. Their diverse interests were well suited to a student body of bright nonconformists. Or so the faculty thought. By the late 1970s, the department found itself confronted by a tiny revolution, an uprising among graduate students. What the students wanted to learn, no one could teach—a barely formed, ill-defined new discipline called chaos.

A decade later, chaos is one of the fastest-growing fields in science, offering a new way of finding order in systems that appear to have no order at all. Medical physicists see surprising order in the fatal disorder that can conquer the human heart, a spasmodic twitching





First, red and blue blobs of paint appear as separate points in model. Then, as paint is mixed, the points are stretched in model. Finally, swirls of paint seem messy, but model shows a continuing orderly pattern.

that is the prime cause of sudden, unexplained death. Economists are digging out old stock-price data and trying a new kind of analysis. Insights that began with pure physics and mathematics have led directly to the natural world—the shapes of clouds, the paths of lightning, the microscopic intertwining of blood vessels, the galactic clustering of stars. Scientists are finding universal patterns in the behavior of the weather, the behavior of cars clustering on expressways, the behavior of oil flowing in underground pipes. The new science has begun to change the way business executives make decisions about insurance, the way astronomers look at the Solar System, the way political theorists talk about the stresses leading to armed conflict.

New ideas can have hard births, and the fledgling science of chaos struck at some firmly rooted traditions —for example, the belief that simple systems must produce simple, orderly behavior. When a handful of Santa Cruz graduate students stumbled upon the first tantalizing threads of the new science, they found themselves very much alone. Elsewhere, in a handful of laboratories and physics departments, some passionately iconoclastic scientists were creating a new discipline. A meteorologist, Edward Lorenz, had discovered a mysterious shape, later called a strange attractor, that illuminated the chaotic unpredictability of the Earth's weather. A mathematician, Benoit Mandelbrot, had discovered a related family of patterns that became the foundation of fractal geometry (SMITHSONIAN, December 1983). A physicist, Mitchell Feigenbaum, had discovered unsuspected links between whole families of chaotic systems, developing a theory that would link turbulent fluids to fluctuating electronic circuits to the rhythms of life itself. They were reexamining many seemingly random or chaotic physical systems, finding new ways of writing equations to describe them, and then using computers to create visual patterns from the equations—patterns that were not obvious in any other way.

For students catching wind of these tantalizing developments, it was hard to see how to proceed. The education of a physicist depends on a system of mentors and protégés. A good mentor helps his student choose problems that will be both manageable and

Photographs by Yoav/Phototake

James P. Crutchfield

Clockwise from bottom, colleagues Jim Crutchfield, Robert Shaw, Norman Packard, Doyne Farmer found mathematical way to detect order in chaotic systems.

fruitful. If the relationship prospers, the professor's influence helps his protégé find employment. But in 1977 there were no mentors in the field of chaos. There were no classes in chaos, no chaos textbooks, not even a chaos journal. The students had to invent much of the subject for themselves—and in so doing, they managed to develop much of it for everyone else.

Chaos at Santa Cruz began with a bearded Boston native and Harvard graduate named Robert Stetson Shaw, who in 1977 was about to turn 31. That made him a little older than most graduate students, his Harvard career having been interrupted several times for Army service, commune living and other impromptu experiences somewhere between those extremes. Shaw was quiet—shy, in a forceful sort of way. He had reached a point just a few months away from completing his doctoral thesis on superconductivity, then a respectable, if somewhat stagnant, subject. No one was particularly concerned that he was wasting time downstairs in the physics building playing with an analog computer.

In the evolution of computers, analog machines represented a blind alley. Digital computers, built up from circuitry that switched off or on, zero or one, no or yes, gave precise answers to the questions programmers asked. Analog computers were, by design, fuzzy. Their building blocks were not yes-no switches but electronic circuits like resistors and capacitors, instantly familiar to anyone who played with radios in the era before the miniaturization of solid-state electronics made it impossible for amateurs to take such devices apart. The analog computer at Santa Cruz was a heavy, dusty thing with a patchboard for its front, like the patchboards used in old-fashioned telephone switchboards. Programming the analog computer was a matter of plugging and unplugging cords.

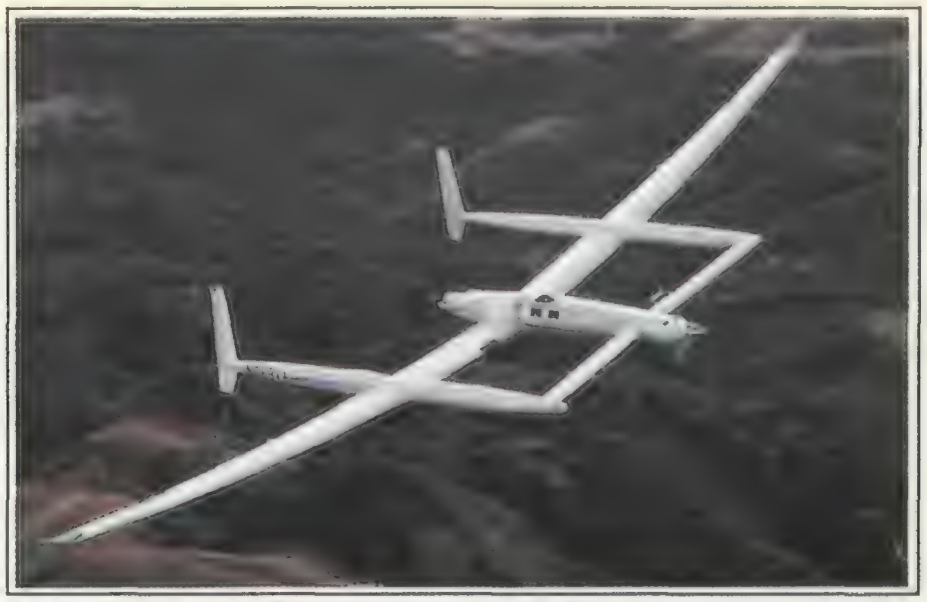
By building up various combinations of circuitry, a programmer simulates systems of equations in ways that happen to be well suited to engineering problems. Say you want to model an automobile suspension to design the smoothest ride. A capacitor takes the place of a spring, inductors represent mass, and so forth. You have a model made of metal and electrons, quite fast and—best of all—easily adjustable. Simply by turning knobs, you can make the springs stronger or the friction weaker. And you can watch the results in the form of patterns traced across the screen of an oscilloscope.

One day an astrophysicist friend, William Burke, handed Shaw a piece of paper with three equations scrawled across it and asked him to plug them into his computer. The equations looked simple. Edward Lorenz had chosen them as a stripped-down method for calculating a familiar process in weather, the rising and falling of air or water, known as convection. It took Shaw just a few hours to patch in the right cords and adjust the knobs. Several minutes later, he saw a peculiar, ever-changing, infinitely entangled pattern appear on the screen and he knew that he would never finish his superconductivity thesis.

Shaw's screen provided a way of creating abstract diagrams of the long-term dynamic behavior of any physical system—a marble sitting motionless at the bottom of a bowl, a monotonously swinging pendulum clock or the unpredictable tumult of the Earth's weather. For the condition of the marble, a steady state, the diagram would simply be a point. For a periodically cyclical system like the pendulum clock, the diagram would be a loop. For the deceptively simple system of three equations for convection, the diagram was something altogether different.

This system of rising and falling fluid behaved cha-

The author is a science writer at the New York Times. *His book* Chaos: Making a New Science *(Viking), from which this article is adapted, was recently released.*



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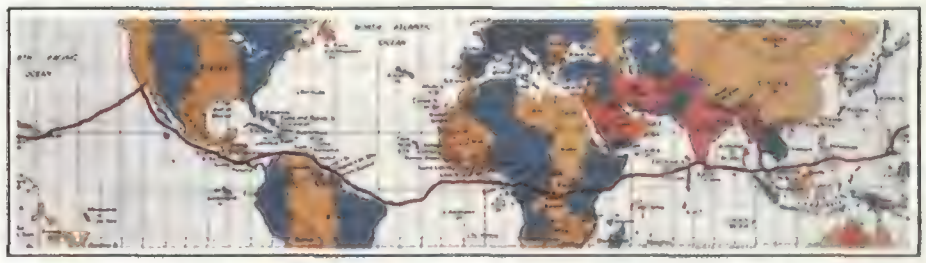
Record-breaking pilots Jeana Yeager and Dick Rutan.



Voyager's irregular flight path, chosen to vector it around strong winds.

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It hadn't been easy. Not even for seasoned pilots who make a routine of record-breaking. Rutan, a retired Air Force lieutenant colonel, and Yeager, a drafting engineer, already held numerous world-distance and closed-circuit titles.

Yet much more than their exceptional personal skills was required to capture this laurel. A radically new plane had to be created by Burt Rutan, Dick's renowned aircraft-designer brother.

Voyager, the revolutionary craft he conceived, has a wing-span longer than a 727's and can carry as much fuel as a tank truck. Yet it's lighter than a small automobile. At takeoff, the gasoline weighed almost four times as much as the 2200-pound plane itself.

Because of the critical need to keep their aircraft light, Rutan and Yeager chose a minimum of instruments. Among them, an automatic pilot, a radar weather unit, and Rolex chronometers.

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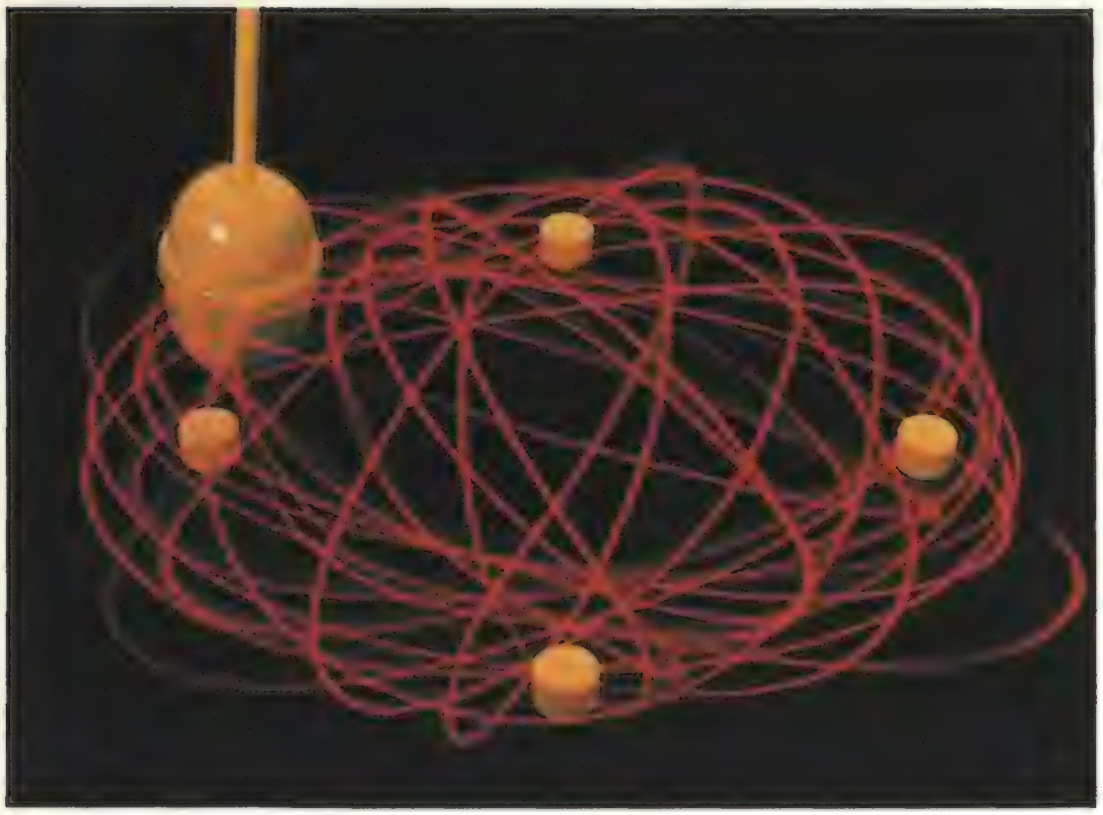

The Lorenz attractor (above) represents cyclical system fluctuating around two points. Magnetic pendulum (left) shows pattern of erratic chaotic behavior.

otically, like the atmosphere itself, a far more complicated but related system. A chaotic system never repeats itself in a periodic way, and the diagram Shaw now began to study never looped around on itself in the same way. Instead it formed an intricate, recursive shape, a sort of double spiral, curling first one way and then the next (above, right). Shaw knew that MIT's Edward Lorenz had discovered this kind of pattern in 1963. Lorenz first recognized its importance while trying to forecast weather on computers. But the chaotic nature of the attractor meant that long-term forecasting would be an impossibility. At the same time, the strange attractor revealed unsuspected patterns. It stood for disorder and unpredictability, yet promised a new kind of order within the turmoil. Two scientists in France, David Ruelle and Floris Takens, had later given such patterns their provocative name, strange attractors. Shaw was aware of the new language of fractal geometry; however, considerable time passed before he, as well as others engaged in similar work, would recognize that the shape before him was a fractal, meaning that it revealed new complexity on smaller and smaller scales.

As it was, he spent several nights in the downstairs lab watching the green dot of the oscilloscope flying around the screen, tracing its chaotic path over and over again, never quite the same way as before. The flow of the shape stayed on the retina, a flickering, fluttering thing, unlike any object Shaw's research had shown him. It seemed to have a life of its own. It held the mind just as a flame does, by running in patterns that never repeat.

As a child, Shaw had illusions of what science would be like—dashing off romantically into the unknown. This was finally a kind of exploration that lived up to his illusions. And he was drawing an audience. It happened that the entrance to the physics department was just across the hall, and the foot traffic was considerable. One of those who started to drop by was Ralph Abraham, a professor of mathematics. "All you have to do is put your hands on these knobs, and suddenly you are exploring in this other world where you are one of the first travelers and you don't want to come up for air," Abraham says. "Rob had the spontaneous experience where a little exploration reveals all the secrets." Soon Shaw had colleagues.

Doyne Farmer, a tall, angular, sandy-haired New Mexican, became the most articulate spokesman for a group that came to call itself the Dynamical Systems Collective (others sometimes called it the Chaos Cabal). In 1977 he was 24 years old, all energy and enthusiasm, a machine for ideas. The youngest member of the group was James Crutchfield, short and powerfully built, a stylish windsurfer and, most important for the collective, an instinctive master of computing. Norman Packard, a boyhood friend of Farmer's who had grown up in the same New Mexico town, Silver City, arrived at Santa Cruz that fall, just as Farmer was beginning a year off to devote all his energy to his plan for applying the laws of motion to the game of roulette.

The roulette enterprise was as earnest as it was farfetched. For more than a decade, Farmer and Packard, along with a changing cast of fellow physicists and hangers-on, pursued it. They calculated tilts and trajectories, wrote and rewrote custom software, em-

bedded computers in shoes and made nervous forays into gambling casinos. It had to be said that the project gave unusual training in the rapid analysis of dynamical systems, but it did little to reassure the Santa Cruz physics faculty. Nor did they understand why Shaw was abandoning his superconductivity thesis. No matter how bored he was, the faculty reasoned, he could rush through the formalities, get his doctorate and move on to the real world. As for chaos, there were questions of academic suitability. No one at Santa Cruz was qualified to supervise a course of study in this field-without-a-name. Certainly no jobs were available for graduates with this kind of specialty.

Nevertheless, the collective took shape. When certain kinds of electronic equipment began to disappear at night, it became prudent to look for them in Shaw's former low-temperature-physics laboratory. Plotters, converters, electronic filters began to accumulate. A particle physics group down the hall had a small digital computer that was destined for the scrap heap; it found its way to Shaw's lab.

Their tinkering sensibility served them well. Shaw had grown up gizmo-oriented. Packard had fixed television sets. Crutchfield belonged to the first generation of mathematicians for whom the logic of computer processors was a natural language. The physics building itself was like physics buildings everywhere, with cement floors and walls that always needed repainting, but the room taken over by the chaos group developed its own atmosphere, with piles of papers and, on the walls, pictures of Tahitian islanders and, eventually, printouts of strange attractors. At almost any hour, a visitor could see members of the group rearranging circuitry, yanking out patch cords, arguing about consciousness or evolution, adjusting an oscilloscope display, or just staring while a glowing green spot traced a curve of light, its orbit flickering and seething like something alive.

The mysterious beauty of nonlinearity

Traditional education in the dynamics of physical systems never revealed the potential of such complexity, because traditional education concentrated on systems that were linear. A linear system obeys laws of proportionality—the faster you go, the farther you travel. Linearity makes calculation easy, or at least manageable. Unfortunately, most real-world systems are nonlinear. They contain some twist, like friction, that does not vary neatly as a function of other variables. Nonlinearity made for hard calculations. It was the fly in the predictable ointment of classical mechanics. Few thought of nonlinearity as a creative force; yet it was nonlinearity that created the mysteriously beautiful patterns of strange attractors.

Jim Crutchfield poses for video portrait (left) that's made by technique that transforms image into chaos.

Doyne Farmer shows son how small computer under his right foot is used to predict roulette—approximately.

"*Nonlinear* was a word that you only encountered in the back of the book," Farmer says. "A physics student would take a math course and the last chapter would be on nonlinear equations. You would usually skip that one."

Shaw and his colleagues had to turn their raw enthusiasm into a scientific program. They had to ask questions that could be answered and that would be worth answering. They sought ways of connecting theory and experiment—there, they felt, was a gap that needed to be closed. Before they could even begin, they had to learn what was known and what was not, and this itself was a formidable challenge.

They did not know it, but their problems were emblematic of the hurdles faced by pioneers in chaos at many widely separated institutions—a handful of researchers, often working alone, afraid to discuss their unorthodox ideas with their colleagues. The Santa Cruz students were hindered by the tendency of communication to travel piecemeal in science, particularly when a new subject jumps across the established subdisciplines. Often they had no idea whether they were in new or old territory, and indeed, some of their work paralleled discoveries by Soviet mathematicians. They quickly realized that many sorts of questions could be asked about the possible behaviors of simple physical systems and the strange attractors they produced. What are their characteristic shapes? What does the geometry reveal about the physics of the related physical systems? A physicist wants to make measurements. What was there in these elusive moving images to measure? Shaw and the others tried to isolate the special qualities that made strange attractors so enchanting. Unpredictability was one—but where were the calipers to gauge such a quality?

By now the collective was meeting regularly in an outsize old Santa Cruz house not far from the beach. The house accumulated flea-market furniture and computer equipment devoted to the roulette problem and to the search for strange attractors. By living with strange attractors day and night, the young physicists began to recognize them (or think they did) in the flapping, shaking, beating, swaying phenomena of their everyday lives.

They had a game they would play. They would ask: How far away is the nearest strange attractor? Was it that rattling automobile fender? That flag snapping erratically in a steady breeze? A fluttering leaf? "You don't see something until you have the right metaphor to let you perceive it," Shaw says. Before long, his astrophysicist friend Burke was quite convinced that the speedometer in his car was rattling in the nonlinear fashion of a strange attractor. And Shaw, settling on an experimental project that would occupy him for years, adopted as homely a dynamical system as any physicist could imagine: a dripping faucet.

As a generator of organization, the dripping faucet offers little to work with. But for a beginning investigator of chaos, the dripping faucet proved to have certain advantages. Everyone already has a mental picture of it. The data stream is as one-dimensional as can be: a rhythmic drumbeat of single points measured in time. None of these qualities could be found in systems that members of the Santa Cruz group explored later—the human immune system, for example, or the troublesome beam-beam effect that was inexplicably degrading the performance of colliding particle beams at the Stanford Linear Accelerator Center to the north. In the dripping faucet, the single line of data is all there is. And it isn't even a continuously varying velocity or temperature—just a list of drip times. The drips can be regular. Or, as anyone can discover by adjusting a kitchen faucet, they can turn irregular and seemingly unpredictable.

Waterdrops not as simple as they seem

Asked to organize an attack on such a system, a traditional physicist might begin by making as complete a physical model as possible. The processes governing the creation and breaking off of drips are understandable, if not quite so simple as they might seem. One important variable is the rate of flow. (This had to be slow compared to most hydrodynamic systems. Shaw usually looked at drip rates of 1 to 10 per second, which meant a flow rate of 30 to 300 gpf—gallons per fortnight.) Other variables include the viscosity of the fluid and the surface tension. A drop of water hanging from a faucet, waiting to break off, assumes a complicated three-dimensional shape, and the calculation of this shape alone was, as Shaw says, "a state-of-the-art computer calculation." A drop filling with water is

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Norman Packard uses computer-generated snowflakes, or fractals, to understand patterns of crystal growth.

like a little elastic bag of surface tension, oscillating this way and that, gaining mass and stretching its walls until it snaps off. A physicist trying to model the drip problem completely by writing down sets of equations and trying to solve them would find himself lost in a deep, deep thicket.

An alternative approach would be to forget about the physics and look only at the data, as though they were coming out of a black box. Given a list of numbers representing intervals between drips, could an expert in chaotic dynamics find something useful to say? Indeed, as it turned out, methods could be devised for organizing such data and working backward into the physics, and these methods became critical to the applicability of chaos to real-world problems.

Shaw began halfway between these extremes, by making a sort of caricature of a complete physical model. He roughly summarized drip physics by imagining a weight that is hanging from a spring. The weight steadily grows. The spring stretches, and the weight hangs lower and lower. At a certain point, a portion of the weight would break off. The amount that would detach, Shaw supposed arbitrarily, would depend strictly on the speed of the descending weight when it reached the cutoff point.

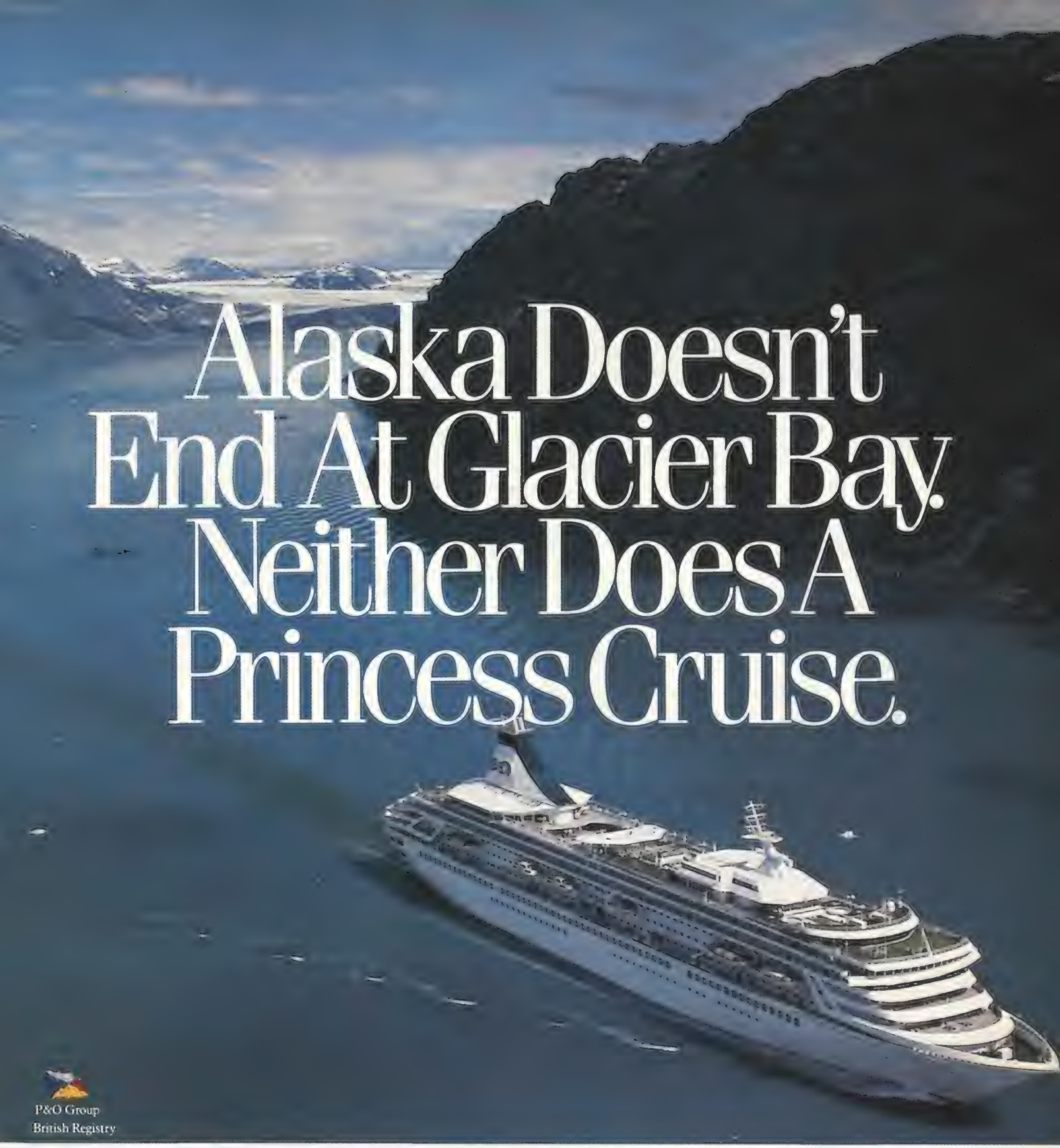
Then, of course, the remaining weight would bounce back up, as springs do, with oscillations that graduate students learn to model using standard equations. The interesting feature of the model—the *only* interesting feature—was a nonlinear twist that made chaotic behavior possible. The precise timing of a drip depended on the flow rate, of course, but it also depended on how the springiness of this bag of surface tension interacted with the steadily increasing weight. If a drop started off its life already moving downward, then it would break off sooner. If it happened to start on the rebound, it would be able to fill with a bit more water before it snapped.

Sitting under a big plastic tub of water

Would Shaw's model generate as much complexity as a real faucet? And would the complexity be of the same kind? Shaw found himself sitting in a laboratory in the physics building, a big plastic tub of water over his head, a tube running down to a premium-quality hardware-store brass nozzle. As each drop fell, it interrupted a light beam, and a microcomputer in the next room recorded the time. At the same time, Shaw had his equations up and running on the analog computer, producing a stream of imaginary data, which closely matched the drips from the real faucet. But to go further, Shaw needed a way of taking raw data from any experiment and working backward to equations and strange attractors that would reveal hidden patterns.

With a more complicated system, one variable could be plotted against another, relating changes in temperature or velocity to the passage of time. But the dripping faucet provided only a series of times. So Shaw tried a technique, developed by the Santa Cruz group, that may have been its cleverest and most enduring practical contribution to the progress of chaos—a method of reconstructing an unseen strange attractor that could be applied to any series of data at all. For the dripping faucet data, Shaw made a graph in which the horizontal axis represented a time interval between a pair of drops and the vertical axis represented the time interval between the next pair. If 150 milliseconds passed between drop one and drop two, and then 150 milliseconds passed between drop two and drop three, he could plot a point at the position 150-150.

That was all there was to it. If the dripping was regular, the graph would be suitably dull. Every point would land at the same place. The graph would be a single dot. Or almost—actually, the first difference between the computer dripping faucet and the real dripping faucet was that the real version was subject



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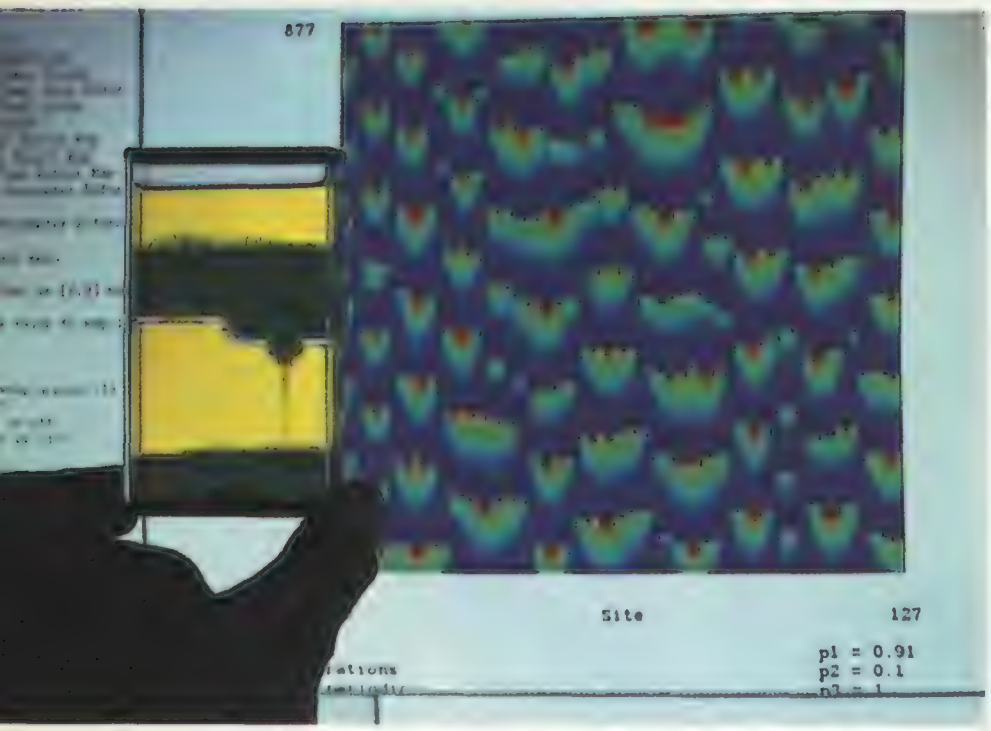

Drops of falling water—in egg timer at left and in computer model at right—flow in similar patterns.

to disturbances, or "noise," and exceedingly sensitive. Shaw ended up doing most of his work at night, when foot traffic in the physics corridor was lightest. Noise meant that, instead of the single dot predicted by theory, he would see a slightly fuzzy blob.

As the flow rate was increased, the system would go through a sudden change in character. Now drops would fall in repeating pairs. One interval might be 150 milliseconds, and the next might be 80. So the graph would show two fuzzy blobs, one centered at 150-80, the other at 80-150, and so on. The real test came when the pattern became chaotic as the flow rate was changed again. If it were truly random, points would be scattered all over the graph. But if a strange attractor were hidden in the data, it might reveal itself in a fuzzy but distinguishable pattern.

Often it turned out that three dimensions were necessary to see the structure, but that was no problem. Instead of plotting each interval against the next, the scientists would plot each interval against each of the next two. It was a trick—a gimmick. Ordinarily, a three-dimensional graph required knowledge of three independent variables in a system. The trick gave three variables for the price of one. It reflected the faith of these scientists that order was so deeply ingrained in apparent disorder that it would find a way of expressing itself even to experimenters who did not know which physical variables to measure.

In the case of Shaw's dripping faucet, the pictures illustrated the point. In three dimensions, especially, the patterns emerged, resembling trails of smoke from an out-of-control skywriting plane (p. 134). He could match plots of the experimental data with data produced by his computer model, the main difference being that the real data was always fuzzier, smeared out by noise. Yet the structure was unmistakable.

As the months went on, the transition from rebel to physicist was slow. Every so often, sitting in a coffeehouse or working in their laboratory, one or another of the students had to fight back amazement that their scientific fantasy had not ended. *God, we're still doing this and it still makes sense*, as Crutchfield would say. *We're still here. How far is it going to go?*

Most of the physics faculty found themselves in a difficult position. "We had no adviser, nobody telling us what to do," says Shaw. "We were in an adversary role for years, and it continues to this day. We were never funded at Santa Cruz. Every one of us worked for considerable periods of time without pay, and it was a shoestring operation the entire way, with no intellectual or other guidance." Each member of the collective was taken aside from time to time for heart-to-heart talks. They were warned that, even if somehow a way could be found to justify doctorates, no one would be able to help the students find jobs in a nonexistent field. This may be a fad, the faculty would say, and then where will you be? Yet outside of the redwood shelter of the Santa Cruz hills, chaos was creating its own scientific establishment, and the Dynamical Systems Collective had to join it.

The turning point was a surprise appearance at a midwinter meeting on condensed-matter physics in Laguna Beach in 1978. The collective was not invited, but it went nonetheless, bundling itself into Shaw's 1959 Ford ranch-style station wagon, an automobile known to them as the Cream Dream. Just in case, the group brought some equipment, including a huge television monitor and a videotape. When an invited speaker canceled at the last minute, Shaw stepped in and took his place.

"We could hypnotize them with flashing lights"

The timing was perfect. Chaos had already attained the status of buzzword, but few of the physicists attending the conference knew what it meant. So Shaw began by explaining the different kinds of attractors, from ordinary to strange: first, steady states (where everything stops); then periodic cycles (where everything oscillates); then chaotic strange attractors (everything else). He demonstrated with his computer graphics on videotape. ("Audiovisual aids gave us an edge," he says. "We could hypnotize them with flashing lights.") He illuminated the Lorenz attractor and the dripping faucet. The talk was a popular triumph, and in the audience were several members of the Santa Cruz faculty, seeing chaos for the first time through the eyes of their colleagues.

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But the collective could not go on forever. The closer it came to the real world of science, the closer it came to unraveling. Its members began thinking about their individual futures, and they began collaborating with established physicists and mathematicians elsewhere. Having learned to look for strange attractors in flapping flags and rattling speedometers, the scientists made a point of finding the symptoms of chaos all through the current literature of physics. Peculiarities that had been dismissed as noise—surprising fluctuations, regularity mixing with irregularity—now began to be explained in the terms of the new science. Such effects popped up in papers on everything from lasers to electronic circuitry.

By the time the collective departed—for the premier institutions of physics, from Los Alamos National Laboratory to the Institute for Advanced Study in Princeton to the University of California, Berkeley—some of the Santa Cruz faculty had turned to chaos, too. Certain physicists felt in retrospect that Santa Cruz had missed an opportunity to begin the kind of national center, for work in the nonlinear equations defining chaos, that began appearing on other campuses. But all the same, they were joining a movement: chemists, ecologists, economists, climatologists now find themselves trying to reconstruct strange attractors from crude data, just as Shaw had in his dripping-faucet studies. Experts on finance use the techniques developed by the Santa Cruz group to sift through decades of daily stock market data, for example, seeking patterns they believe must be there. Many physiologists now believe that chaos provides a way of predicting—and perhaps treating—erratic rhythms in the processes that govern life, from breathing to heartbeats to brain function. At MIT, medical physicists are comparing human electrocardiograms with data from a computer model of the chaotic heart twitches in an attempt to predict well in advance when the organ may undergo fatal spasms. Some ecologists are using the mathematics of chaos to explore how, in the absence of random environmental changes, populations of species could erratically increase and decrease on their own.

Packard studies the tendency of chaotic processes to create complex patterns in phenomena such as snowflakes, whose delicate lacework embodies a mixture of stability and instability that is only now beginning to be understood. He and Farmer use the physics of dynamical systems to study the human immune system, with its billions of components and its capacity for learning, memory and pattern recognition. To these scientists and their colleagues, chaos has become a set of tools for unraveling apparent randomness. But it is also a set of attitudes toward complexity—a new way of seeing. They feel that they are turning back a trend in science toward analyzing systems in terms of their constituent parts—quarks, chromosomes or neutrons. "The trend in science, and in physics in particular, has been toward reductionism, a constant breaking things down into little bitty pieces," Farmer says. "What people are finally realizing is that that process has a dead end to it. Scientists are much more interested in the idea that the whole can be greater than the sum of the parts."

Opposite: seemingly random flow of waterdrops from faucet, studied by Robert Shaw, was found to have a normally undetected order when times between drips were graphed (above), revealing "strange attractor."

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By Peter Stark

The yearlong search for a perfect sled to ride down Jumbo

From troika to luge, we have always sought the fastest and most thrilling ways to propel our bodies over the ice and snow

The problem was that we broke too many sleds. It's not surprising, really. We are, after all, decades older —though perhaps no wiser—than your average sledder, and our aging frames carry plenty more flesh. Our sled run was no lightweight, either: a treacherous, twisting, quarter-mile chute that was capable of thrashing both sled and driver.

The sled run was my friend Steve Krauzer's bright idea. One gray winter afternoon, Krauzer—normally a hardworking novelist and responsible adult—pulled the plug on his word processor, seized a shovel and marched out through snowdrifts to his Missoula, Montana, backyard. Packing the snow into curving ridges, he built a small sled run.

Later, with the help of friends, Krauzer lengthened the course, expanding it up the lower flanks of Mount Jumbo, a grassy, rounded mountain that rises behind his house. It was a run that offered a leg-punishing exercise on the way up, and on the way down a wild-eyed, snow-spraying ride that terminated with a tumble into a snowbank near the window of Krauzer's vacant office. It was the perfect antidote to the midwinter blues.

Surprisingly, our bodies usually withstood the pounding; our sleds, however, did not. It was this that finally sent us on our quest: the search for a sled that could handle rough treatment, tight turns and Jumbo's fickle snows. The search would send us scouring through secondhand stores, poring over toy catalogs, browsing through libraries and consulting with sledders from several countries. We would learn that, over thousands of years, the sled has evolved from one of Man's first vehicles into one of his most sophisticated toys. And we would learn that its scope is enormous, embracing everything from bone-runnered sledges to $12,000 Italian-built racing bobs, virtual cruise missiles mounted on steel runners.

From the start a bobsled was out of the question (too costly and it needs an iced track), but we planned to test any other sleds we could lay our hands on. And when we found the perfect sled, we planned to haul it to the very peak of Mount Jumbo, and from there we would plunge 1,368 vertical feet to Krauzer's backyard.

In some respects, history has shunned the sled as if it were some rustic country cousin and instead has bestowed its laurels on that much younger sophisticate, the wheel. Centuries before the wheel's arrival, however, the sled hauled freshly killed game through the forests of northern Europe, where prehistoric wooden runners have been unearthed from bogs. Nor was it confined to lands of snow and ice; 4,000-year-old stone carvings portray Sumerians, Assyrians and Egyptians hauling giant stone blocks and statues on sledges.

On dry land, of course, a sled creates a lot of friction; some carvings depict workers pouring lubricant beneath the runners—water, or possibly milk, its butterfat acting like oil. Others show the sledge runners rolling over rounds of wood. Appearing about 3500 B.C., the wheel surpassed the dry-land sledge, except on particular terrain (witness the horse-drawn farm sledges called stone boats).

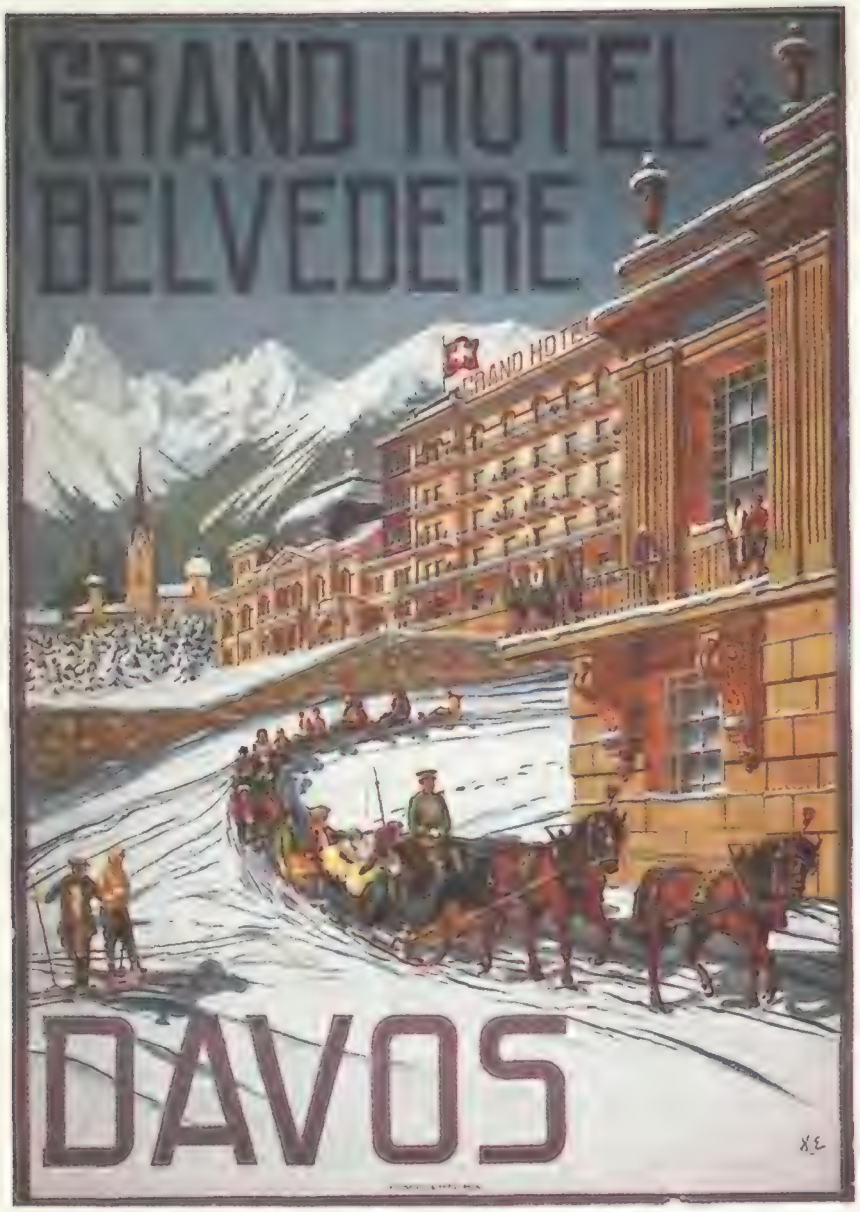
Ice is a very slippery substance

In one situation, specifically, the sled was tough to beat—on snow and ice. For reasons still not fully understood, ice ranks as one of the slipperiest substances known. Its slickness may result partly from a lubricating layer of water that forms under the pressure or frictional heat of sled runners, as well as from partial rotation of molecular bonds in which water molecules act almost like roller bearings. So, on ice, the sled became the most efficient way to haul heavy cargoes.

Throughout the globe's northern regions, the sled, over millennia, developed in its many permutations: the dogsled of the Eskimos, the toboggan of the North American Indians, the Laplanders' *pulka*—shaped like a sawed-off canoe and towed by reindeer.

In the snowy parts of Europe, sleds eventually were hauling everything from manure to royalty, the latter

Whimsically painted turn-of-the-century girl's sled was made by the Morton family in their Maine factory.



Poster promoted Davos, Switzerland, where the first international sled race took place February 12, 1883.

riding in horse-drawn sleighs carved in the shapes of dragons, swans and other beasts. The sleigh's popularity spread: Russians bundled up in three-horse troikas, while Americans dashed about in cutters. There were booby hutches, shifters and driving sleighs, not to mention pungs, pods and pony sleighs.

But Krauzer and I weren't much interested in pungs or pods for our high-speed slide down Jumbo. In this, we simply were following the age-old impulse that prompted Indian boys to fly downhill on sleds of wood or bone, and those Roman soldiers who, with spears for steering poles, supposedly rode their shields down the snowy passes of the Alps.

Despite the antiquity of the concept, however, it wasn't until the late 19th century that downhill sledding flourished as an organized sport and sled design blossomed into high art. Since then, sleds have appeared in dozens of styles, shapes, colors, sizes, but our research revealed that most fall into one of three major groups. In turn-of-the-century Europe, these groups were designated by nationality: a sled then was known as either an American, a Canadian or a Swiss.

Water was painted by Claude Deruet in the 17th century for Cardinal Richelieu's palace. Among sleigh

Krauzer and I decided we'd better try one of each.

The American sled we knew intimately from our New England and Midwestern boyhoods. It's that long, low model, sometimes called a clipper, that's ridden belly-whopper style. This means headfirst, straight downhill, as fast as possible.

The American version of "coasting" extends back into the Colonial era; Boston Common already was a favorite sledding hill by the time of the American Revolution when British soldiers, camped on the Common during the winter of 1775-76, destroyed the

Peter Stark is a free-lance writer—and sledder—who divides his time between Missoula and New York City. Currently he is in China researching a book.

races and gamboling couples, the barge (left) carries the royal family—with Louis XIII wearing a helmet and classical costume—toward rock temple of glory. Cardinal Richelieu stands at the gate to welcome them.

sled runs. This wanton act prompted the boys of Boston to take their grievances to General Gage, the British commander.

"What!" he replied. "Have your fathers been teaching you rebellion, and sent you here to exhibit it?"

The boys responded that they hadn't harmed the general's troops, yet the soldiers persisted in destroying the sled runs and "we will bear it no longer!" The general, admiring their "love of liberty," promised that the sled runs would be left alone.

"All coasting in those days was racing, pure and simple," wrote James D'Wolf Lovett of his Boston boyhood in the 1850s. "Prominent sleds were as well known among the boys as racehorses and yachts are today." He describes sleds built of polished black walnut and upholstered in enameled leather bordered by gold tacks, materials suitable for a fine piece of furniture. Their names—*Raven, Comet, Flying Cloud*—reflected the owner's hopes for a fast descent, and their runners—the key to speed—were forged of the best "silver steel" and "kept burnished like glass." As one writer put it, "A slow sled was worse than none."

The earlier American sleds tended toward stubbiness and stout, solid-wood construction, or were improvised of items such as beef bones mounted on a board, or a single barrel stave to which a seat had been nailed. (This often uncontrollable contraption, known as a jumper or a skipper, could send its rider spinning round "ker-whack into an apple tree" and was said to have no equal among the entire roster of

Stacked 26 feet deep, a record 56 logs were hauled by sled on Washington's Birthday, 1895, in Minnesota.

A 19th-century illustration shows well-dressed gents decorously riding toboggan down North Woods slide.

sliding devices "for dare-devil, exhilarating sport.")

With sledding's new sophistication in the latter part of the 19th century came not only an abundance of models, but also strict rules of behavior: racing headlong, boys went "belly-whacker" on clippers but girls "sat up straight," according to one obviously male memoir. "The ethics of society seeming to deny them the privilege of 'belly-buster,' and on high sleds —nothing could be more ignominious than a 'girl's sled,'—scraping and screaming, showing glimpses of red flannel petticoats as they prodded with their heels, acting much like frightened hens scuttling through a yard, they plowed to their goal."

Eighty-two-year-old Henry W. Morton remembers when "sleds had gender"; his family's company was building them. One of the nation's first sled makers, the Paris Manufacturing Corporation of South Paris, Maine, today is its largest. Presided over by Henry W.'s son Henry R., it was founded in 1861 by his grandfather, Henry F., who had hoped to go to college but suffered eyestrain from studying and took up sled building in his kitchen. The finished products were painted by his wife. The operation grew, and today collectors seek these kinds of hand-painted sleds (p. 138). "I've heard prices all the way up to $700 for a Paris sled that was maybe $3 when new," says Morton.

America's most famous sled is an old wooden clipper—*Rosebud*, a central symbol in the 1941 film *Citizen Kane*. The sled turned some heads a few years ago when film producer Steven Spielberg paid $60,500 at Sotheby's for a balsa-wood *Rosebud*. This, it turned out, was one of three copies made of the original hard-

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wood *Rosebud,* which had been purchased for $12 shortly before *Kane*'s filming. Two copies were incinerated during the making of the movie; the third, Spielberg's, eventually turned up in a studio warehouse. The original *Rosebud* apparently belongs to Art Bauer of Long Island, who in 1942 at the age of 12 was awarded it for winning an RKO-sponsored contest.

Early sleds like *Rosebud* had no steering devices; in the late 1880s that changed, thanks to Samuel Allen, a Philadelphia farm-implement manufacturer who is to the sled what the Wright Brothers are to the airplane. Allen invented the flexible-steering sled, since immortalized as the Flexible Flyer, a name stamped on the subconscious of almost any American who grew up near snow. Where riders previously steered by dragging toes or heels or by jerking the sled sideways, with Sam Allen's new sled you merely pulled the steering arm, thus bending the slender steel runners in the desired direction of travel. Eventually, the Flexible Flyer (this year marks its centennial) and sleds like it dominated the American sledding scene.

They still do. While in total volume American sled makers may now sell a greater number of plastic sliding devices such as saucers and trays, the flexible-steering clipper retains its title, king of America's sledding hills. You can look at this two ways: the American sled, little changed in 100 years, is stuck in the Dark Ages, or conversely, there's no need to improve upon perfection. Either way, Krauzer and I needed one; we found it at a local toy store, a five-foot-long Speedaway.

We were looking for a toboggan, too. The 1880s, a great decade for sledding on both sides of the Atlantic, also witnessed a tobogganing craze in the United States and Canada. Known in some circles as a Canadian, this Indian device had long hauled goods over North America's deep snows and had been adopted for military transport during the French and Indian War. British soldiers stationed in Canada (and obviously suffering from cabin fever) rode the capricious machines down hills. The sport became fashionable; tobogganists formed clubs, built giant slides and wore costumes of bright wool blankets with waist sashes. By the 1890s, the tobogganing craze had subsided and coasting had reverted to its truest fans—the small boys and girls (who eventually overcame the stigma against belly-whacking) out for a chaotic afternoon at the local sledding hill.

All fall, Krauzer and I laid our plans. On sunny Indian-summer days, we hiked Jumbo's grassy flanks, scouting routes. Gloomy Saturday afternoons found us analyzing the sled inventories of local toy stores. Christmas approached and the deliveryman deposited several large packages at my door. I ripped them open to find some of the fanciest sleds I'd ever seen.

Everything was falling into place. Everything, that is, except snow. Looming above town, Jumbo stood nearly naked. Anxiously, we watched the skies.

Two adults eagerly awaiting sledding season, we seemed an oddity in America. But in Europe, sledding is serious sport that has been evolving steadily for the past hundred years; comparing the two is like comparing the kerosene lantern and the halogen lamp.

European sledding heated up in the past century when the fogbound British discovered that the sun

Sledding in the past century held to certain strict conventions, with proper young ladies seated upright.

The pursuit of a better slide has always inspired innovation: witness these bicyclists on sled runners.

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The search for the perfect sled

Luger tests skills and aerodynamics at Lake Placid on one of world's most technically demanding tracks.

Gunter Sachs turns at Junction point on Cresta Run wearing St. Moritz Tobogganing Club uniform.

shone brilliantly in the Alps during the winter. Frequenting Switzerland's mountain spas, the British, always game, took to riding about on the little *handschlitten* (later known as a Swiss), the handsled that Swiss postmen took up and down the snow-covered mountain roads. It was exemplary sport, both for British gentlemen and their long-skirted ladies. Ernest Hemingway described the ex-military governor of Khartoum roaring along on a tiny sled, muffler blowing straight out behind him and a cherubic smile on his face: "It is easy to understand how the British have such a great Empire after you have seen them luge."

Then they started racing. Organized by British literary critic John Addington Symonds, the first international sled race took place down a two-mile road at Davos on February 12, 1883. Contestants rode European-style—sitting upright, their feet in front.

Only a few years later, however, in the 1887 running of the Davos race, a New Yorker by the name of L. P. Child easily outran the Europeans. Child, as one British sledding historian put it, possessed "that healthy disregard for old-established usage which is one condition of the progress of his nation." He won belly-whacking headfirst on an American-style clipper named *America*. No sooner had Child dismounted,

Cresta sled has a moving seat which a rider can slide forward or backward by shifting his weight around.

writes T. A. Cook, "than every intelligent man realized the great advance that had been made."

A foolish tendency exists among sledders, as Krauzer and I soon discovered, to climb ever higher up the hill. In 19th-century Switzerland, this manifested itself in the evolution of racecourses from simple mountain roads to treacherous ice-coated chutes. One of the first was the legendary Cresta Run at St. Moritz, site of a sporting ritual and social gathering that's still going strong a century later. During the 1880s, a fierce rivalry burned between the sledders of Davos and those of St. Moritz. So, with design help from a Swiss geometrician and under the supervision of Major W. H. Bulpett, the Cresta was built into a three-quarter-mile test of British mettle. It featured drop-offs called leaps, huge banked turns named Battledore and Shuttlecock, and straightaways where today's riders, belly-whacking on what are called Cresta sleds (Bulpett's design, a steel skeleton with movable seat), reach speeds of 80 miles per hour with their noses pushed down to within a few inches of the ice. Overlooking this bizarre scene is a glassed-in clubhouse where, as one rider puts it, "Europe's most elegant women, in their voluminous furs, sit sipping things."

But Mount Jumbo boasts no glassy clubhouses, and furs there are worn by the occasional elk or bear. Krauzer and I rejected the Cresta sled as way too specialized for Jumbo's rugged slopes. We had other vehicles to consider, and much more to learn.

There was still another form of sled racing derived from riding the little handschlitten feetfirst down mountain roads. Over decades, the roads became icy chutes, and the riders reclined to an aerodynamic, flat-on-the-back position. The sleds, gaining flexible runners manipulated with the feet, grew lower and wider, and sleekened into what are today's fearsome 48-pound racing luges. Inscribing perfect arcs across the walls of icy curves, withstanding the crush of a rider experiencing several g's, the luge is the Ferrari of the sledding world.

For the lugers, a $15 million lizard's tail

About 300 miles due north of Krauzer's backyard, near Calgary (where the 1988 Olympic Winter Games will be held), a $15 million tube of concrete, lined with ice, coils down a slope like the tail of some giant white lizard whose ferocious bulk lies just over the hill. We stand next to the track and watch a luge shoot out of a turn, whistle past about six feet away at about 70 mph and vanish into a tunnel-like curve.

At Calgary for a practice session is Wolfgang Schadler, a soft-spoken former Olympian from Liechtenstein, and the young, new coach of the U.S. National Luge Team. We have lagged behind the Europeans in competition as well as in the technique—essential for obtaining maximum speed—of preparing a luge's runners, or "steels." But the gap is narrowing in this art in which Schadler is an acknowledged expert.

"The roundest steels are the fastest," he explained over lunch one afternoon. Unlike sharp steels, he said, "they don't cut the ice and everything goes very smooth. But you cannot control steels that are too round. The sled goes *psscccchhhh*"—he makes a wavering motion with his hand. "You must find the middle, the optimum point that is sharp enough to drive a line and round enough to go fast." Shaped with files and polished with diamond paste, the edge must also take account of the luger's riding style and body weight, as well as track configuration, ice temperature and other factors.

Another consideration in a luge's speed is air resistance. Try holding your hand out a car window at 70 mph and you'll understand the reason for the sliders' shiny, skintight plastic suits, their pointed boots—and why they climb into wind tunnels with their sleds, seeking sleeker riding positions.

But frontal drag is only part of the aerodynamic problem, explained Karl Young, an engineer who has worked closely with the U.S. team. Air washes over

In scene from 1941 film *Citizen Kane*, the young Kane grips his *Rosebud* clipper as he greets his guardian.

sled and slider and swirls about behind, like the eddy made by a river washing over a rock. Called turbulence drag, this hindering force could be reduced by adding a tapered airfoil to the rear end of the sled, said Young. "If you wore a conehead helmet—like on *Saturday Night Live*—you would be very fast."

That's exactly what the West Germans, looking very eggheaded, wore during the 1976 Olympics, but officials then banned the helmets, citing safety reasons. With mere hundredths of a second separating the winner and the also-ran, it is easy to understand why a luger will try anything. Many innovations have been outlawed over the years by both luge and bobsled authorities. "They don't want NASA coming in and designing a one-runnered sled with a computer balance system," explained Robert (Bullet Bob) Hughes, marketing director of the Lake Placid-based U.S. Luge Association. "They want it to look like a luge."

Sledding is taken seriously at Lake Placid, home to both a luge and a bobsled track. Most everywhere else in this country, though, sledding is the province of children. Compare this with Europe, where sledding ranks as a family sport and mountain resorts offer sled tracks as well as ski trails.

One popular European form of sledding, called *naturbahn*, represents a compromise between a lighthearted outing at the local hill and a high-g-force ride across the iced walls of a luge track. The name means natural track; without high-banked turns, the course consists of a snow-covered road, hiking trail or curving track marked out on an open hillside, to be taken at speeds of 30 to 50 mph, often in a race against the clock.

There's no telling whether organized sledding will catch on here, though efforts are under way. We continue to associate sledding only with days when deep snows have sealed school doors shut; wild rides help us escape life's cares as well as gravity.

The big day finally dawned. A storm had plastered Jumbo with fresh snow, but a warming trend crept close behind. It was now or never. On a Tuesday afternoon, towing two sleds each and carrying crash helmets, we slogged skyward through lingering shreds of storm cloud that wreathed the mountainside.

We knew where to go. A great hump rising above the city of Missoula, Jumbo was named after Barnum's elephant. A sled ride down its precipitous rear end or flanks would send us plunging either into Hellgate or Rattlesnake canyons, the former containing the twin concrete ribbons of Interstate 90, the latter cradling a sleepy neighborhood where folks probably wouldn't appreciate a sledder free-falling from the sky and plunging like an arrow into the backyard. But on Jumbo's "trunk," a gentle, open ridge, we'd found a route starting at about the top and winding nearly a mile, almost to Krauzer's back door. It presented only two major obstacles: a barbed-wire fence near the bottom, and a headwall midway that, in the lingo of the Cresta Run, we dubbed Deadman's Leap. It was for this we carried crash helmets.

Testing the entire sled arsenal

Mounting the ridge, we broke through the gray cloud bank into blue skies and bright sunlight. We began to sweat under the heat of the sun and the weight of the sleds that we'd picked so carefully. Earlier, with a dozen eager friends, we'd tested our entire arsenal: several flexible-steering clippers (nice, but breakable); a toboggan (fast, rugged, tough to steer); an old Swiss (built to last—I'd ridden it as a child); a bulletproof plastic number (we called it the SST, as in supersonic transport); and a high-tech German Swingrodel, sporting a hinged seat that flexed articulated runners (I've yet to master it).

For our big descent, I'd carefully considered a naturbahn luge, a sturdy, smooth-riding Cadillac of a sled, but in the end both Krauzer and I opted for that old standby—the clipper. On a clipper, you can drag your feet behind. A clipper felt familiar. A clipper felt *secure*. Yes, there was irony here. After our months-long international search, the model I ultimately dragged up Jumbo was a durable old Hiawatha Meteor that I'd picked up for $19.95 two years earlier at Paul's 2nd Hand Store.

We paused to rest halfway up Jumbo's trunk. Above us loomed the headwall of Deadman's Leap. We were

both thinking the same thought: "Boy, are we gonna be hauling by the time we get there."

Finally, we stood on a knoll at the top of our run. Far below, clouds shrouded the valley, obliterating the city. Mountain peaks jutted from the soup. It was a view you'd expect from an airplane window, not a sledding hill. But the first guy down the Cresta Run probably had second thoughts, too.

We tied padding to our sleds. Krauzer recklessly volunteered to go first.

We strapped on our helmets. Krauzer allowed how maybe he'd retire from competitive sledding if he survived this run.

We knocked snow from the runners. Krauzer asked me to tell his girlfriend that it had been a good—albeit short—life.

We shook hands and Krauzer picked up his sled, belly-whopped onto it and was gone. I caught a last glimpse of his boot soles as he disappeared round a bend. I could still hear the sled rattling over bumps and ruts. Then there was silence.

"Hey!" A voice floated up from below. "I'm stuck!"

Sitting at Krauzer's kitchen table drinking beer late that day, we analyzed our descents. We'd had some good bouncing plunges down Deadman's Leap—toes dragging, snow spraying—but on the flatter sections our sleds bogged down in the soft, wet snow. We'd successfully completed maybe half our route. What we really needed, we decided, was a good freeze. Maybe a couple inches of new snow. Or the fancy prototype sled I'd just seen, or maybe if we packed down the course regularly, or. . . .

Far above Krauzer's kitchen table, Jumbo looms, waiting for the perfect sled, the perfect snow.

Like any grown-up kid, author Peter Stark rides belly-whopper-style on his bumpy descent of Jumbo.

In the end, he chose the old, durable Hiawatha Meteor he had bought for $19.95 at Paul's 2nd Hand Store.

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THE *Heartbeat* OF AMERICA

TODAY'S CHEVROLET

Decades after Philip II built San Lorenzo de El Escorial, an anonymous painter meticulously recorded it on copper. Austere yet charming, it contains a church, college, monastery, palace, royal pantheon.

By Robert Wernick

Philip II's grand design for the glory of God and empire

From El Escorial, his palace in the Sierra de Guadarrama, Spain's king moved armies, fleets, staunchly defending the faith of his fathers

Every messenger reaching the King of Spain's campaign headquarters swelled the scope of the success. The entire French force was destroyed at Saint-Quentin, half of it killed or wounded, the other half taken prisoner or on the run. The king's exultant generals, including the Duke of Savoy, were all for pressing on through the hundred undefended miles to Paris and wiping the French monarchy, a hereditary enemy, off the map. Philip II, whose official nickname was Prudentissimus, was not so sure. Great things were possible, he wrote to his father that evening, but characteristically he added *"si no falta dinero"* (provided the money holds out).

Of course it did not hold out, as it never seemed to when he needed it most. Philip was the richest man in the world. Every year his fleets brought him immense cargoes of silver and gold from the conquered kingdoms of the New World. But this was the 16th century; nobody had quite invented central banks or paper money. All that bright bullion pouring ashore in Cádiz seemed to ooze and trickle away between there and the battlefield. Master of half the world,

Philip was at that moment short on cash and credit. Who was going to pay for the fodder for the hundreds of horses that would be needed to drag his guns over the wretched roads from Saint-Quentin to Paris?

So the battle, though it brought enormous prestige to the Spanish Army and led to a peace that lopped off a few towns from the kingdom of France, had no profound influence on European history. But it did lead to the creation of one of the great European monuments.

The battle was fought on the feast day of Saint Lawrence, August 10, 1557; during the fighting Philip's artillery set fire to the church of Saint Lawrence in Saint-Quentin. Being an extremely devout monarch, he felt a debt to this saint, martyred during the Roman persecutions by being roasted alive on a gridiron. Philip ascribed his victory at Saint-Quentin to the intercession of this saint, and ordered that his bones be rescued from the burning church. He then resolved to dedicate what would become the greatest building project of his reign to Saint Lawrence.

A place for grandeur and solitude

The site was chosen with great care, near the little mining village of El Escorial (Escorial has a lilting sound but means slag heap) close to the geographic center of Spain. It was high enough in the foothills of the Sierra de Guadarrama to have cool clean air in summer, as well as a splendid view stretching 30 miles across the dry, dusty Castilian plain to Philip's new capital city of Madrid. The mountains were full of wild pigs and deer for Philip to hunt, and good, hard, pyrite-flecked granite to be quarried nearby. It was a place for grandeur and solitude, a place where Philip could govern his empire and commune with his God. The building was called San Lorenzo de El Escorial and it was meant to stand alone on the mountainside, free from the ordinary distractions of courts and cities —the bustling summer resort that now sprawls at its feet was the product of a later, laxer century.

The king had two architects of genius, Juan Bautista de Toledo and Juan de Herrera. From beginning to end, though, Philip watched over and approved every step of El Escorial's design and construction: the ground plan—a gridiron, perhaps to recall the instrument of Saint Lawrence's torture—as well as the unornamented, monumental style of its buildings.

Philip's plan began with one of the dying wishes of his father, Charles V, the Holy Roman Emperor: a suitably somber and majestic crypt in which, from his death onward, all the kings of Spain might be buried. Above the crypt Philip wanted a church. Around the church, in a great rectangle, he wanted a royal palace, a monastery, a library, a hospital and a center of learning. It was an immense undertaking, with 6-foot-thick walls, 9 towers, 88 fountains, 2,618 windows and 14 interior courtyards. The church in its center was really a private chapel for the king and his family, high officials of the court and resident monks of the order of Saint Jerome, but Philip wanted it to have a dome resembling that of St. Peter's in Rome.

The workers were well organized, well disciplined and well paid. Diego Suarez, one of the great adventurers of that age of adventure, writing his memoirs as an old man, recalled *el buen plato,* the good food

Philip was painted in armor before Battle of Saint-Quentin, but he followed action from a safe distance.

Twilight glow softens severity of Escorial's main facade, now restored; Sierra de Guadarrama is beyond.

The stately, harmonious library boasts luminous frescoes personifying the Liberal Arts and Theology.

that was served. No gambling or swearing was permitted on the construction site. The architects and engineers used laborsaving machinery like two-wheeled cranes and ingenious building methods such as working the stone at the quarry and transporting it direct to its proper place. The job was completed by 1584, in the incredibly short time of 21 years, and the result was hailed as the eighth wonder of the world.

Posterity would not be kind to the king or to his creation. For reasons of state and religion he did some dreadful things, but he did not seem to enjoy doing them. Many historians of the past 400 years, especially those writing in English, have had an anti-Spanish or anti-Catholic bias, and they have done their best to turn this most Spanish and Catholic of monarchs into some kind of monster. He was regularly portrayed as a pitiless, bigoted persecutor, who loved to see heretics writhing in the fire. They have painted him as the murderer of his own son (the Don Carlos characterized as a tragic hero in Schiller's play and Verdi's opera), who in real life was a homicidal maniac and whose death, though mysterious, is no longer generally attributed to Philip. With justice he has been blamed for the execution of the noble Flemish patriots Count Egmont and Count Horn, and made responsible for the assassination of William of Orange; but he has been questionably described as the would-be murderer of Queen Elizabeth I of England, and of his third wife, Elizabeth of Valois, whom he loved dearly and who actually died in childbirth. (He was, as a matter of fact, a devoted family man, tender and courteous to all his wives, even the temperamental frump Mary Tudor, Queen of England and Ireland from 1553-58 and still known as Bloody Mary.) He has also been viewed as a dull, plodding, bloodless bureaucrat who sat spiderlike in a dark cell weaving evil plots, who squandered the riches of Spain on grandiose projects like the "Invincible Armada" and the palace of the Escorial, leaving his country impoverished, depopulated, doomed to decay.

El Escorial's own reputation has hardly fared better. Art critics have often found it bare and sterile. In the middle of the 19th century a sprightly Argentine exile reported smugly that not 20 visitors a week came to this "barbarous and somber" pile, which Philip had constructed with the "sweat of Spain and the booty of

In 1987 the peripatetic author has contributed articles to this magazine on smokestacks (September), Jacob Lawrence (June) and Paul Klee (February).

In foreground is armillary sphere; spines of books face inward so pages are exposed to circulating air.

Beneath basilica's high altar, marble and bronze sarcophagi hold remains of Spanish kings and queens.

war . . . so that two hundred friars could sing a *miserere* over freedom of thought, which he had assassinated." Baedeker, the guidebook from which generations of earnest 19th- and 20th-century tourists learned the proper opinions about the art of Europe, condemned the Escorial for "lacking the divine spark. . . . Philip II had the misfortune of belonging to an epoch which shone neither for creative force nor for taste."

Today we are not quite so censorious of 16th-century people for behaving in 16th-century ways. Thousands of visitors tramp through the Escorial every week, except those parts of it that still function as monastery and institution of higher learning. Tourists need feel no shame about admiring what is now recognized universally as a unique architectural masterpiece. They also—thanks to an ongoing exhibition opened in 1984 by Spain's Patrimonio Nacional to celebrate the 400th anniversary of the building's completion—can learn about the techniques of its construction, admire its treasures and gain some insight into the complex mind of its builder.

You can follow Philip II's life by looking at the portraits done of him, from the elegant Renaissance prince of 24 who posed for Titian in 1551, to the hollow-cheeked old man of the last years, dressed in somber black. None of the portraits reveals very much about his inner feelings, for Philip had been taught by Charles V to trust no one, and he became a master at keeping his thoughts and his plans secret. He was not an extrovert or daring combatant like his father. But he was enormously conscientious, doggedly faithful to his country and his church, and did his backbreaking duty as king for 42 years without a word of complaint.

Critics tend to overlook the sheer scale of the job thrust upon him when he was still in his 20s. He was lord and master of what today would be called a superpower. There were two superpowers in the 16th century—Turkey in the East, Spain in the West. Like his contemporary, Süleyman the Magnificent, Philip was responsible for running a huge multinational empire. His titles take up line after line on official documents: King of Castile, of Aragon, of Portugal, of the Indies (that is, most of Central and South America), of Jerusalem, of the Two Sicilies, Duke of Milan, Duke of Burgundy, Count of Flanders, Count of Holland—the list goes on and on. Just getting the news of what was happening in all these places took a maddening length of time, a minimum of two weeks from Brussels or Naples, six months from the Philippines, which in

Philip was painted with wife Mary Tudor, Queen of England from 1553 until 1558, the year she died.

Bizarre allegory sums up plight of Netherlands under Spanish rule: Elizabeth I of England feeds Dutch cow held by William of Orange, with Philip astride, Duke of Alba milking, Anjou clutching tail.

1542 had been named for the 15-year-old heir to the throne by the Spanish explorer López de Villalobos. Every year he had to worry about the possibility of famine, plague, a Turkish invasion. He had to worry about Protestant rebellion in the Netherlands, Moorish rebellion in the south of Spain, Algerian pirates in the Mediterranean, English pirates in the Atlantic. He had to worry about his uncle Ferdinand I, the new Holy Roman Emperor, who had succeeded Charles V but was soft on heresy. He had to worry about religion and religious wars.

In an age when some rulers changed religion as easily as they did their coats, he was stubbornly faithful to the Roman Catholic Church. But what could he do about his slippery sister-in-law Elizabeth of England? She was a heretic, which was bad, but if he got rid of her, the throne would go to Mary Stuart, a good Catholic but married to a Frenchman, which was worse. When the cantankerous old Pope Paul IV called him a "putrid member" and "that little beast" and tried to take Naples away from him, what could he do but send an army against Rome?

He had to worry about the Indians in his new American domains. It had been decided that they had souls, but how best could they be saved? How could he support the monastic orders he sent there to convert them? He always had to worry about money. Three times the mighty King of Spain had to declare himself bankrupt.

No wonder he took his time about making decisions. Time and I can take on any other two, he liked to say. Historians have made fun of him for procrastinating his way past opportunities like that given him by the victory at Saint-Quentin. But he had his spectacular successes too, like the Battle of Lepanto in 1571, in which a Spanish fleet, with those of Venice and the Papal States, under his bastard brother Don John of Austria, destroyed the Turkish navy. It took considerable talent just to hold all his scattered dominions together during 42 years of war and crisis. When he died, in 1598, he left his son Philip III more territory than any other man has reigned over before or since.

In his quiet way he understood that such immense domains could not be ruled by the sword, as his father had tried to do by riding with his armies back and forth across Europe and even crossing to North Africa to besiege Tunis. He worked out for himself the way the modern state would have to be run—by paper. Every day, whatever other ceremonials required his royal presence—dances, bullfights, autos-da-fé—he spent hours reading state papers, recommendations by his council, reports from his spies, petitions from his subjects. They came to him on folio sheets with very wide margins, which he filled with scrawled notes, observations, corrections, suggestions and commands.

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Don Carlos, Philip's son by his first wife, Maria of Portugal, was imprisoned by father, died mysteriously.

As king he felt duty-bound to be interested in everything. He tells his ambassador in Rome to tell the Pope to mind his own business. He specifies the amount of lace to be worn on the court costumes of counts and barons. He warns the Duke of Medina Sidonia, commander of the Invincible Armada, that the English ships will unchivalrously fire cannonballs at him instead of closing in to fight it out with cold steel (but unfortunately he does not tell the Duke what to do about it). He approves the export of some Andalusian horses. He devises a detailed scenario for handling the Baron Montigny, a Flemish rebel convicted of high treason: garrote him in his prison cell, announce that he has died of fever, give him a handsome burial with 700 royal masses for the repose of his soul. (This is the Philip that history loves to hate.) He corrects his secretaries' errors of geography and spelling.

It was too much for any one man to do, but he did it anyway. He preferred doing it in the Escorial because, far away from the distractions of Madrid, he could get through four times as much paperwork in a day. It was a place mainly for work and prayer.

If it was the king's workplace, he regarded it as belonging first to God and second to Philip, and he made sure God got the lion's share of everything. Rising dramatically from the mountainside, the palace might have been expected to have its main facade facing the plain, to overawe visitors riding up from Madrid. Philip would have none of that; the church had to be oriented in the traditional way so the priest at the altar faced east, toward Bethlehem and Calvary. If that meant cramping the main entrance by putting it in the west wall facing the mountains, that was what had to be done. The church, built in the form of a Greek cross and surmounted by an immense cupola and dome, is central to the complex. The king's quarters are in an outthrust of the church on the east side.

Like the builders of the Italian Renaissance, Philip and his architects were seeking the classical harmonies of ancient Greek and Roman temples. The biggest courtyard in the Escorial, the one leading up to the church, measures 210 feet by 126 feet, the measurements given by the Roman architect Vitruvius as ideal for a space of this sort. The builders were going back beyond Vitruvius, however. They were heirs to a mystical tradition holding that the Universe is built on number and proportion. In the ceiling of the library is a painting showing ancient sages, Pythagoreans and naked gymnosophists of India constructing *anima*, the human soul, out of numbers.

Introducing these ideas to Spain was a revolutionary step. Traditionally, Spaniards—much of whose country had been occupied by the Moors for 700 years—covered their buildings with extravagant Moorish-style ornament. But here in the dry heartland of Castile, Philip was speaking for another Spain—austere, proud, dignified, devout. He wanted a building stripped to geometric essentials. Long before Mies van der Rohe, he had decided that less could be more. The Escorial is all cubes, spheres and pyramids—cubes symbolizing the solidity of the Earth; spheres symbol-

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Blasting away at Turkish ships off Greece in Battle of Lepanto in 1571, galleons of Spanish, Venetian and Papal States demolished the Turkish navy of Süleyman, thus saving the Mediterranean for European powers.

izing the perfection of heaven; pyramids, in the form of lines rising and converging to an invisible point, forming a connection between the two.

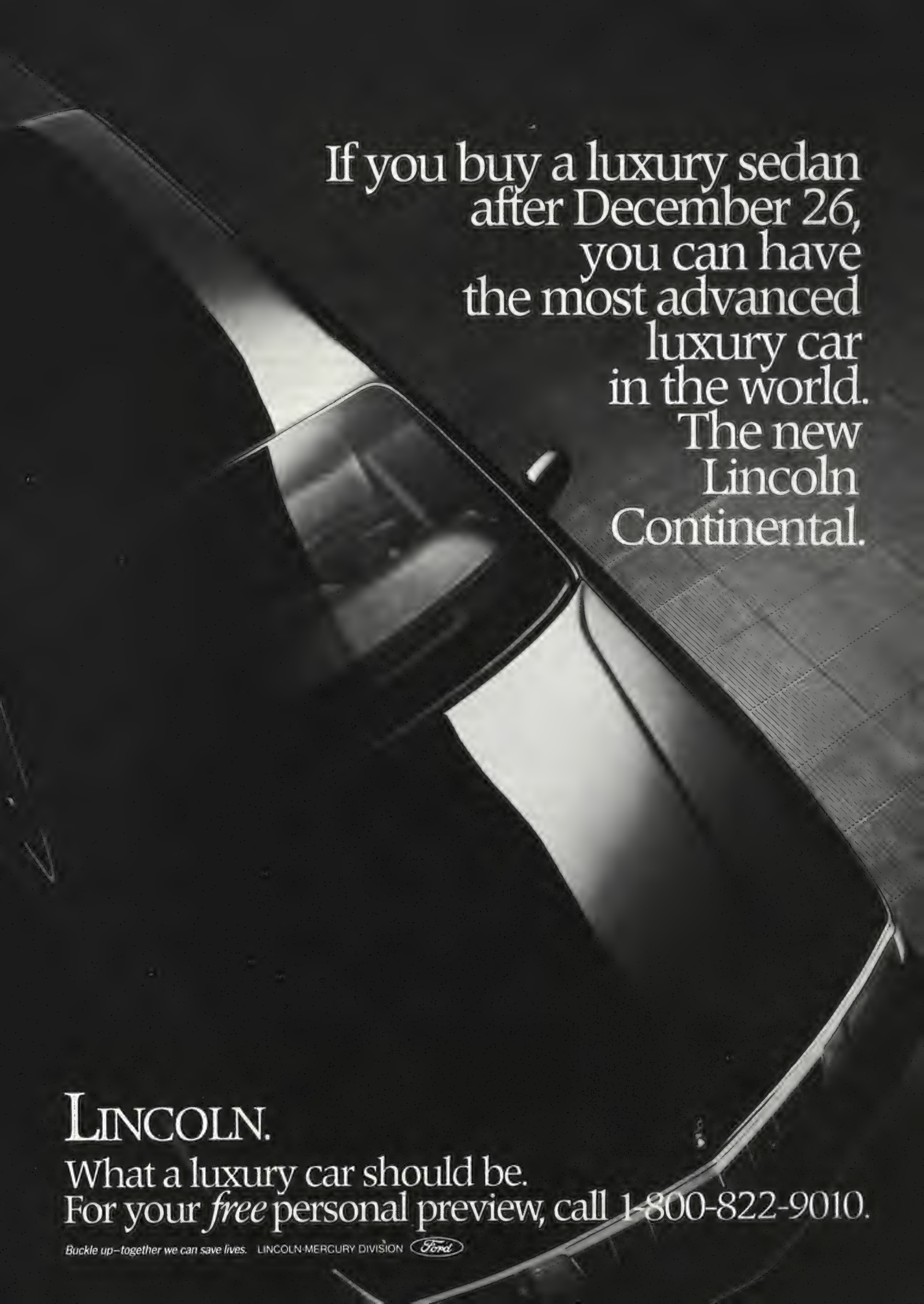
The south facade is a long, bare rectangle with 286 windows in regular rows. A window pattern on this scale is almost bound to be boring, even in the Versailles of Philip's great-grandson Louis XIV, even in the Seagram Building. But Juan de Herrera, with his subtle spacing of the rows of windows and the cornice overhanging the second row, the arcades upholding the terrace at the foot of the wall, the reflecting pool, conveys a sense of movement. The eye of the beholder is carried along as by a slow, formal Spanish dance.

The bareness of Escorial's facade was an exact reflection of the king's personal style. His bedroom and study, just off to the right of the high altar, are brick-floored and as austere as possible, with a door opening into the church, which itself is all aflame with marble, jasper, bronze and gold. The retable behind the altar was meant to be the most magnificent in the world, soaring 86 feet, with paintings in swirling dramatic colors by artists of the Italian Mannerist school.

There was no contradiction in Philip's mind between austerity and magnificence. In the palace, the throne he sat on was deliberately bare and simple, a campstool that his father had taken around on his campaigns. But the long hall leading to the throne room was lined with elaborate, specially commissioned paintings of some of his own most important battles.

Philip was a connoisseur of painting. When the monks of the Escorial sat down to supper in their refectory, Titian's *Last Supper* looked down on them from the wall. Philip was a patron of Titian's, as had been his father, and the king corresponded with the painter regularly and bought a number of paintings.

Philip's art collection, some of it inherited, was remarkably catholic. Next to Titian, he loved the often erotic, mystical fancies and sour human observation of Hieronymus Bosch. And when he wanted a picture and couldn't get it, he sometimes had it copied, meticulously and full size, and shipped to the Escorial. Whenever a collection was put on sale in Europe, his agents were there. He commissioned two El Grecos and collected a number of Northern Renaissance mas-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For his funeral, the king ordered vestments of black velvet, with skulls and crossbones worked in silver.

ters, among them Bosch, Hans Baldung Grien and Quentin Metsys. Even after being plundered by Napoleon, and after more than 150 of its paintings were carted off to the Prado in Madrid, the Escorial remains one of the world's great museums.

The salubrious air of the Escorial has done wonders for the works of art, which over the years have not had to suffer from the ailments common in polluted urban centers. Some of the palace rooms have been redone in elegant 18th-century style to please Bourbon kings who found Philip's structure too grim to suit them. These rooms contain their own treasures, including a superb series of tapestries created in the late 18th century illustrating daily life in Spain and woven from cartoons by the young Goya.

In the great vaulted hall of the library, with its frescoes by Pellegrino Tibaldi, the same air has kept the leaves of the books crisp and easy to turn for the past 400 years. It is probably the only library in the world today where books are put on shelves with their spines against the wall (common practice in the 16th century), so that clean mountain air can seep more easily between the gilded pages. When Philip assembled it, it was the greatest library in Europe, with some 4,000 volumes of his own and 5,000 more that he had gathered from monasteries and palaces around Spain. Many of its collections, including medieval Arabic and Hebrew manuscripts, are unique, so to this day scholars have kept coming. It also contains a large number of works that were condemned by the Inquisition. Had Philip not saved them, they might have disappeared entirely.

He has often been described as a prince of darkness, but the Escorial shows how much he loved light. Two rows of windows flood the library with sunshine in early morning and early evening, the best hours for study. Clear windows in the giant cupola light every corner of the church. The 14 interior courtyards, of varying proportions and sizes, make sure that every room in the palace, college or monastery receives its fair share. The sun was a physical blessing. The king insisted that the monks get the southern part of the building so they would be a bit warmer in winter.

Proclaiming the one true faith

The Escorial was a spiritual symbol of the faith he was sworn to uphold, the one that the Council of Trent had proclaimed to be the one true faith, *quod semper, quod ubique, quod ab omnibus* (because it was believed in forever and everywhere and by all men). It was also an ideal place from which to rule over half the world strictly according to the rules. It was hardly Philip's fault that they were changing. By the 16th century, the one true faith was no longer believed *ab omnibus*. It had been replaced by, in Philip's view, the detestable Protestant formula *Cujus regio ejus religio* (Each state to the religion of its ruler). And, though no one realized it at the time, the day of the 16th-century superpowers (sometimes known as the Age of Kings) was over. Spain and Turkey might continue to dazzle the world for another century or so but they had neither the manpower, nor the resources, nor the tough mercantile mentality needed to maintain themselves as great powers in the modern world. The Mediterranean, which was the center of their vital in-

terests and had been the center of the civilized world for many centuries, was being turned into a backwater.

The struggle for the future control of the globe had moved north and west to troublesome countries that Philip did not understand. He had learned to hate the English climate in the three years when, by his marriage to Mary Tudor, he had been titular King of England. He hated the beefy, beer-guzzling nobles of Germany and the Netherlands who expected him to join in their swinish revels. He hated sending his men to fight a never-ending war against the Dutch in a gloomy land where, as one of his soldiers wrote, "there grows neither thyme, nor lavender, figs, olives, melons, or almonds . . . where dishes are prepared, strange to relate, with butter from cows instead of oil." Some historians have argued that the empire might have been easier to control if Philip had moved his capital to Lisbon or to Brussels where he and future monarchs would have been closer to the sea routes of the Atlantic. But he was never tempted.

Were he to come back to life today, he would not be pleased by most of 20th-century culture, but he would be happy that monks are still meditating and chanting in the Escorial, and that the college he founded is still in operation—its most distinguished graduate today is Juan Carlos, King of Spain, Philip's descendant in the 14th generation.

Philip was active, still filling the margins of his state papers, still hunting, into his 71st year. When his gouty leg swelled up to become useless and infection began to attack his arms, he said, "Since I must go to the Escorial anyway to fill my tomb, I might as well go there to die." He had himself carried on a litter, seven miserable, jolting days from Madrid.

A king's death was a public event in those days, like his birth and marriage, and for Philip it was only one more official ceremony to be gone through. His sufferings went on for 14 weeks and they were atrocious, his limbs rotting away, the doctors not daring to treat them or bandage them because of the pain, the smell so bad that courtiers found any excuse to stay away. He bore it without murmur, keeping open the little door to the church so he could hear the monks chanting for the salvation of his soul.

Pious group in gilded bronze by Pompeo Leoni flanks high altar of San Lorenzo el Real at Escorial.

From right: Philip, wives Anna, Elizabeth, Maria, son Don Carlos; wife Mary Tudor is buried in London.

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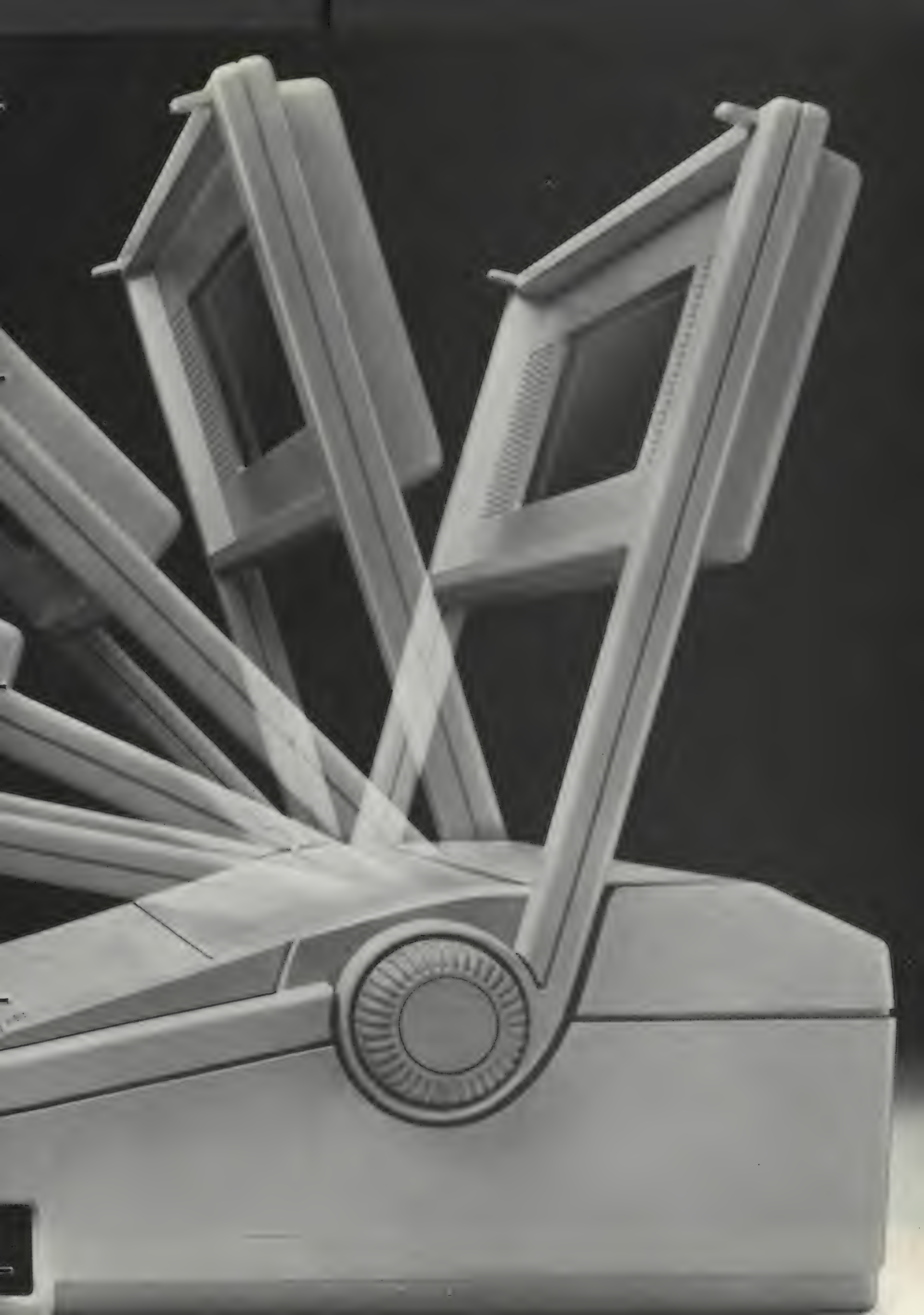

By Richard Wolkomir

She's an artist whose explosives make a lasting impression

Evelyn Rosenberg gets a big bang out of her art. She creates sculptures from metals that are molded by explosions in the desert

Squinting into the brilliant New Mexico sun, Evelyn Rosenberg ignores the mobile M-110 howitzer parked beside the brown mountain. She also disregards the blown-apart jet fighters strewn across the desert. Instead, she anxiously watches several technicians laying explosives atop four metal sheets she has positioned on the stony ground. For the past three years she has been visiting this firing range, which is operated by the New Mexico Institute of Mining and Technology in the arid hills above Socorro. Here the school's Terminal Effects Research and Analysis group slams missiles into tanks and jets, studying the results. But Rosenberg, who has the tawny eyes and long, center-parted brown hair of a Saharan Tuareg, is not interested in "terminal effects." She is an artist, and this violent landscape is her alfresco atelier, its explosives her oils and brushes. "When those DETASHEETS go off, it'll look like overkill," she tells a visitor as the technicians cut the rubbery sheets of flexible explosive to size.

Until recently, Rosenberg was a maker of etchings that often depicted mythological or zoological themes. Now she is pioneering a novel art form, which she and her husband have dubbed "detonography" after much consultation with thesauri and dictionaries. Detonography—art created by explosives—is the off-

Rosenberg shows work in progress outside her New Mexico studio. Face emerges from hole made by blast.

Photographs by Ovak Arslanian

Over sketch of a recent project, *Forest Floor*, artist places wings, leaves to be imprinted on metal sheet.

A technician hooks up detonating cord attached to "sandwiches" of molds, metal and explosives in desert.

shoot of a new technology. Engineers are learning to use the power of explosives to shape metal parts for airplanes and rockets, weld metals in awkward spots and bond disparate metals into laminated hybrids. Rosenberg detonates DETASHEETS to create stunningly complex metal sculptures expressing the accretion of geologic time, the mysteriousness of beasts, the impulse toward religion, the universality of myth.

The process begins in her studio behind the Albuquerque house that she shares with her husband, Gary, chairman of the neurology department at the University of New Mexico School of Medicine, their two children, Oren, 14, and Mica, 8, and a green parrot named Tukey. Amid the studio's neatly ordered gear—a massive etching press, tongue depressors for mixing ink, hair dryers for drying prints, wrenches, rows of bottled chemicals—Rosenberg draws many of her ideas on paper. She grips the pencil in what might pass for a mechanic's squared-off hand, the forefinger and pinkie wrapped in Band-Aids because of metal cuts. As the pencil darts, hesitates and glides, an image takes shape —perhaps the skeleton of a brachiosaur. Rosenberg repeatedly consults reference books in her library about such things as the curve of a shinbone or the crenulation of a palm frond, but she is more interested in design and artistic effect than scientific accuracy.

When the drawing seems right, she reproduces it in bas-relief on metal tooling foil, pressing out the lines with a chopstick or some other blunt tool. The foil then becomes a template for making a mold. Placing it in a box, Rosenberg pours a tough plaster over it. An hour later, when the plaster has set, she lifts it from the box and pulls off the foil. This hardened block, bearing her original design, is now the "mother mold."

Rosenberg uses a couple of other techniques to make molds. Sometimes she creates forms in sand and pours the plaster directly into them. Other times she sculpts her impressions in clay.

On explosion day, the artist gently loads her mother molds into the back of her Dodge Caravan, along with the sheets of metal—stainless steel, brass, copper or aluminum—that will bear the final images. Then she drives the 70 miles from Albuquerque to Socorro, following the Rio Grande south. The rugged terrain along the way reminds her of the Negev desert: stony plains stretched out under a shimmering sun, with stark brown mountains brooding on the horizon. This scenery is a major source of her artistic inspiration. She points to a shaft of sunlight slanting down from behind a cloud to illuminate a mountain peak. "That's straight from *The Ten Commandments*," she tells her companion, grinning.

Rosenberg grew up far from the Southwest, in the leafy Maryland suburbs of Washington, D.C. After majoring in philosophy and English literature at the University of Maryland, she studied comparative religion at the Hebrew University in Israel, where she acquired her fascination with deserts. It was a stay in India, however, that made her an artist. "I was struck by the Indians' use of art as a stimulus for religious experience," she says. Back in Israel she took a drawing course and then—watching images materialize under her pencil—she opted for a new career, studying art at Columbia University, learning printmaking at the Rochester Institute of Technology, earning a master's degree in art at the University of New Mexico. "I liked

Richard Wolkomir, who never saw an explosion until he went to New Mexico to report this story, says: "The ground shook, I was a bit stunned."

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the hard, physical work of making prints," she says. "I liked getting dirty, too."

Eventually, however, Rosenberg found two-dimensionality limiting. She longed to escape the confinement of flat surfaces and experimented with various ways of doing so. Then one day a tall, graying stranger knocked on her door, carrying some metal plates under his arm. Gideon Sivan was an Israeli military explosives expert. At that time, he was doing research on nonmilitary uses for explosives at the New Mexico Institute of Mining and Technology. He was particularly interested in a phenomenon known since the days of Alfred Nobel, dynamite's inventor. If something is interposed between an explosion and a surface, its image will imprint on the surface. The reason is that an explosion's force flattens whatever it hits—"It squooshes the molecules together," as Evelyn Rosenberg puts it. Even so flimsy an intervening object as a feather will buffer the blast somewhat, leaving the surface behind it slightly less flattened, so that a silhouette of the object appears in relief.

Sivan was pursuing the notion that the principle of explosive imaging might be used for art, but he needed an artistic collaborator. Mutual acquaintances had recommended Rosenberg as an established printmaker whose works had appeared everywhere from the Museum of Modern Art in Haifa, Israel, to leading galleries in Manhattan, Washington, D.C. and Santa Fe. "Gideon arrived just when I was wondering how to create large, three-dimensional prints," the artist says.

Sivan was simply imprinting images, but Rosenberg had grander notions. She wanted to use explosives to press a metal sheet against a mold. "If it worked, I could match the results of bronze casting at a fraction of the cost." The savings would come from eliminating the expensive foundry work of pouring liquefied metals at high temperatures into molds.

Boom! This is what Rosenberg and others in bunker see when explosion goes off. They watch it in mirrors.

Photographer set up camera outside, on top of the bunker, tripping lens when countdown reached zero.

Artist takes metal sheet, sooty but intact and bearing the impression of plaster mold, from explosion site.

Back in studio, Rosenberg works metal after treating with chemicals. Mask protects her from dust, fumes.

"Our first explosions produced just rubble and shrapnel," she recalls. "My husband thought this was crazy, so when I came home from Socorro I'd sneak all this awful stuff into my studio so he wouldn't see it." When Sivan returned to Israel, the institute's Center for Explosives Technology Research asked Rosenberg to carry on his work under their auspices. She was doing all of her blasting on a massive anvil then. She would lay a "sandwich" atop the anvil: first her mold, then the metal plate that would take the image, then a layer of carefully arranged twigs, feathers, leaves, then a rubber pad to smooth the explosion and finally, on top, the DETASHEET. Each blast would instantly crumble the mold and rocket the twisted metal sheet hundreds of feet into the air.

After 80 blasts, she got it right

One day Rosenberg brought a mold that was too large for the anvil. Impulsively, she laid it on the gravelly surface of the desert. This time, to everyone's astonishment, the blast forced the metal into the mold and left it imprinted with the mold's image in bas-relief. "The explosion's shock waves had been striking the metal anvil and then reflecting back, destroying the mold too quickly," says Rosenberg. "But the ground absorbed the shock and enabled the impression to be made. It took us 80 blasts to start getting it right."

Today she is going to try to get it right again. On a nearby peak, a red flag rises, signaling nontechnicians to clear the blasting area. Rosenberg ushers some fine-arts students from the institute into her van and roars up the steep dirt track to another hilltop. There they file into a thick-walled yellow bunker to view the explosion safely through a mirror system. Far below, tiny technicians in yellow hard hats run Primacord, a detonating cord resembling red rope, from the artist's pyres to their own bunker, where, at a signal, they will set off electric blasting caps. A siren blows. The countdown begins. "Five . . . four . . . three. . . ."

At zero, the desert below erupts, exhaling a huge, expanding ball of flame. A terrific thud shakes the bunker. Now smoke hangs over the valley, small flames licking the ruins of Rosenberg's four altars. She shepherds the students back into the van and races down the mountain to see what the blast has wrought.

Reaching into the mold's rubble, she extracts a brass plate, bent at the corners, and points to several glowing spots where she had placed bits of aluminum and copper foil so that the explosion would fuse them into the brass. "These look a little bright, but we'll see what happens when we work on them with the patinas," Rosenberg comments.

Later, at her studio, she dons a lab smock, covers her hair with a gaudy bonnet and pulls on a tricolor in-

Susan Contreras

Forest Floor looks almost alive when Rosenberg has finished highlighting colors and accentuating textures.

dustrial filter mask. She covers her eyes with welder's goggles. Finally, putting on yellow neoprene gloves to protect her hands from the acids, she is ready to work. "Once a deliveryman came back here while I was doing this and I thought he was going to have a coronary," she says. "I look like a space monster."

Cleaning away the soot with acetone and a wire brush mounted on an electric drill, Rosenberg reveals a dully shining complex of fossils, fern fronds, grasses. Next, she brushes the brass with chemicals bearing such names as Liver of Sulfur and Aluminum Black. These are her patinas. Reacting with the metal, they create patches of black, gold, tarnished silver and gunmetal gray. With sandpaper, Rosenberg shines raised portions, like stems and leaves. "This is fun, because you start seeing things you didn't know were there," she says, her voice muffled by the mask.

Now she attacks the brass with a blowtorch and a household plant sprayer full of copper nitrate, creating reds, blues, greens, purples. With an implement resembling a dentist's drill, she grinds away patinas to bring out fine details, like the veins of a leaf. Her final application is a clear protective coating. "What I really worry about," she says, taking off her mask and goggles to peer at the piece upon which she has been working, "is that I'm creating my own Love Canal right here in the backyard."

Whatever else Rosenberg may be creating, she produces striking art. Her etchings are imaginative excursions on the border between realism and dreams, but her detonographs are even more unusual, full of texture and complexity. Last fall, New Mexico's new, ultramodern Museum of Natural History in Albuquerque unveiled her *Evolutionary Geoscape II*, a large mural installed permanently over the front entrance. It is a stunning demonstration of the artistic possibilities in explosions, an evocation of the past fossilized beneath the Southwestern desert. Bones, beasts, plants, dirt and stone overlay the brass and copper plates, an evolutionary maze where butterflies and bees flutter, spanning the eons from the Paleozoic to now, while trilobites fade into fish and the metal crawls with creatures past and present—prehistoric reptiles and modern lizards, archaeopteryxes and eagles, saber-toothed tigers and prairie dogs, and human bones, buried with pottery. She has signed the mural with her own handprint. "That is how primitive artists did it," she says. Crossing the panels from left to right are naked footprints, the artist's own, as if time were moving ahead, or as if the creator were traversing her own creation.

Explosions are what make this kind of complex metal artwork possible; it could be done no other way. "Metal is hard to work," Rosenberg says. "It's heavy, it's dirty, it cuts you and you need a sledgehammer to make it do what you want. But I like the way it looks when it's finished. It has scale. It has presence. It's a real object."

Not surprisingly, Rosenberg's powerful "objects" are finding an appreciative audience. One detonograph, inspired by ancient New Mexico petroglyphs, is hanging in the Albuquerque office of an executive with the Public Service Company of New Mexico. Another, her first major commission, appropriately enlivens the lobby of the New Mexico Institute of Mining and Technology's fine arts and convention center. The artist is currently working on a large, freestanding metal sculpture for a research firm. A series of obelisks and columns, it is encrusted with microchips, printed circuits, human neurological pathways, ancient rock paintings and chemical formulas—"the secret language of science," she says.

Now another day's blasting work is done. Things have gone well and Rosenberg is pleased. She and a visitor relax for a few moments, gazing out over her beloved desert and talking about her art. "We used to have a huge dog that would obey only me," she says. "Creating art from explosions is a little like handling that ferocious dog. It's a dangerous thing that, to some extent, I can control." From behind her comes the dull thud of a detonation. "Explosions are frightening," she reflects, "but I like the *idea* of them. Genesis, the big bang—creation from destruction!"

Artist puts final touches on detonograph featuring life mask, her hands a counterpoint to hands in metal.

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By Edwin Kiester jr.

Doctors close in on the mechanisms behind headache

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A competitor in a British "migraine art" competition submitted this portrait of pain, complete with zigzag visual disturbance.

It was a headache to make history. On April 8, 1865, Ulysses S. Grant's Union Army was chasing Robert E. Lee's Confederates across Virginia. Grant invited Lee to surrender, but the Southerner demurred. The two armies settled down near Appomattox Court House for the night.

It was not an easy night for Grant. "I was suffering very severely with a sick headache," he recorded in his journal, "and stopped at a farm house on the road some distance to the rear of the main body of the army. I spent the night in bathing my feet in hot water and mustard, and putting mustard plasters on my wrists and the back part of my neck, hoping to be cured by morning."

At dawn the next day, Palm Sunday, Grant felt no better—until a message arrived from Lee. The Confederate general had changed his mind overnight. "When the officer reached me, I was still suffering from the sick headache," Grant wrote, "but the instant I saw the contents of the note I was cured." Pain and nausea gone, the Union general rode off to accept Lee's surrender and end the Civil War.

Most headaches are not so momentous—or so swiftly and miraculously cured. Take the case of Ann Grimes, a patient at the headache clinic at the University of California, San Francisco (UCSF), who has been fighting blinding headaches for 30 years. The siege began when she was in second grade, and by age 20 the bouts of searing pain and vomiting were coming six or seven times a month. At 40, the headaches had decreased in frequency but not in intensity. Sometimes they flattened her for 36 hours at a time.

Of all human ills, headache may be the most ancient and universal, as well as the best documented. Five thousand years ago, an anonymous Sumerian poet described his "sick and blinding" headache in terms Grant or Ann Grimes would have recognized. Aristotle wrote about headaches; John Calvin, Madame Pompadour and Leo Tolstoi are only three of the famous who have suffered from them.

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aching head at some time or other. However bothersome, the pain usually disappears with a couple of aspirin and a good night's rest. For an unfortunate 10 to 20 percent of the population, however, chronic, recurrent and intractable headaches are an incapacitating fact of life. Headaches account for 11.5 million doctor visits a year, 5 million lost workdays, and a cool $1 billion for aspirin and other painkillers. That impact may be understated. Only half of chronic-headache victims ever see a doctor, and most go to work in spite of the pain.

What causes headaches? And what can be done to stop them? For centuries, humans have been tussling with these questions, concocting a long and colorful history cluttered with supernatural explanations and witch doctors' remedies. Today, thanks to an international research effort, science is beginning to close in on the old enemy. New technology allows doctors to actually peer inside the skull and watch a headache develop, leading to a more basic understanding, which in turn could lead to surer cures.

Surgeon chisels into a patient's skull in this 14th-century anatomical treatise.

Dr. Neil Raskin asks a migraine patient about her reaction to ergot compound.

Many prominent researchers are now convinced that some headaches, especially the notorious migraines, arise from an upset in the brain's delicate chemistry and could be distant cousins to the "nerve storms" of epilepsy. There is a suspicion that fluctuations in the levels of a neurotransmitter known as serotonin enhance the brain's ability to sense pain. That shift to a focus on the central nervous system has brought into question the long-held view that the head hurts only because swollen blood vessels stretch trigeminal nerve endings in the face and scalp.

Still, enough mystery remains to keep scientists fascinated—and debating among themselves. "We still can't always cure a headache," says Dr. Neil H. Raskin (left), vice chairman and professor of neurology at UCSF and part of an elite 30-member international research group on migraine and headache. "But we're making progress. We've moved from the dark ages to the bright ages."

The early Christians simply relied on faith. Saint Gregory, Bishop of Tours in the 6th century, cured a se-

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vere headache merely by pressing his painful brow against the rail of Saint Martin's tomb. Other faithful were cured by touching the carpet above the resting place of Saint Julian.

Applying the "cure" directly to the pain-racked head has been a favorite and age-old remedy, foreshadowing today's soothing ice bag. Mexicans in the Sierra Madres stroked the head with a live toad. A priest-physician of Mesopotamia suggested tying on a curative headband woven of the hair of a virgin kid. The Romans and Europeans into the early 20th century tied on a hangman's noose.

As for antiheadache medicines and potions, prescriptions have included herbs, tobacco, marijuana, moss scraped from the head of a statue, roses and candied sugar, dill blossoms boiled in oil. Finally, in 1899, came the synthesis of aspirin, which, if it didn't cure the problem, could temporarily quell the pain. Aspirin and its relatives are still the mainstay for occasional pain relief, but some unfortunates require as many as 16 extra-strength pain relievers a day and may become hooked.

To the victim, one headache often feels like another. But scientists have broken down chronic headaches into categories, as a first step toward understanding and treating them. Perhaps 1 percent are "disease-related" headaches, caused by some underlying ailment or medical problem such as inflamed sinus, pain "referred" from toothache or earache, injury or, more ominously though far more rarely, a brain tumor or stroke. These headaches are treated by removing the underlying cause, if possible. Tension headaches, which may result from stress and produce bands of pain around the forehead, account for about 90 percent of all chronic head pain. Remedies include pain medication, relaxation techniques and sometimes a change of jobs.

A Palo Alto free-lance writer, Edwin Kiester reported on dying trees in the Black Forest in November 1985.

Pain remedies, even at a penny a dose, have been money-makers for millennia.

The remaining 10 percent or so are the true nightmares, and it is here that research is concentrated and that most recent progress has been made. These are the "vascular" headaches and include the infamous migraines. The name comes from the traditional view linking the pain to distended blood vessels; although doctors now challenge the explanation, the classification stands.

Vascular headaches can be nonmigrainous, caused by severe high blood pressure, hunger, fever or sometimes sexual orgasm. The type known as cluster headache, a recurrent, excruciating pain that centers behind one eye and principally affects men, is today considered only a distant cousin of migraine. Of the true migraines, two are dramatic but relatively rare: hemiplegic, which involves paralysis of one side of the body, and ophthalmoplegic, in which there is paralysis of one eye.

Thanks to an impressive roster of big-name victims, it is classic and common migraine that have attracted the most attention. The Greek physician Galen coined the name in the 2d century A.D. He called it *hēmikrania,*

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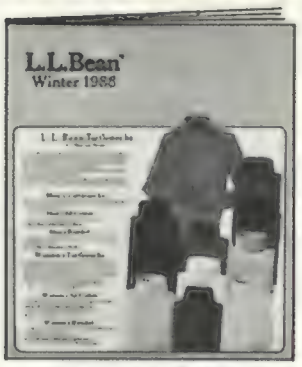

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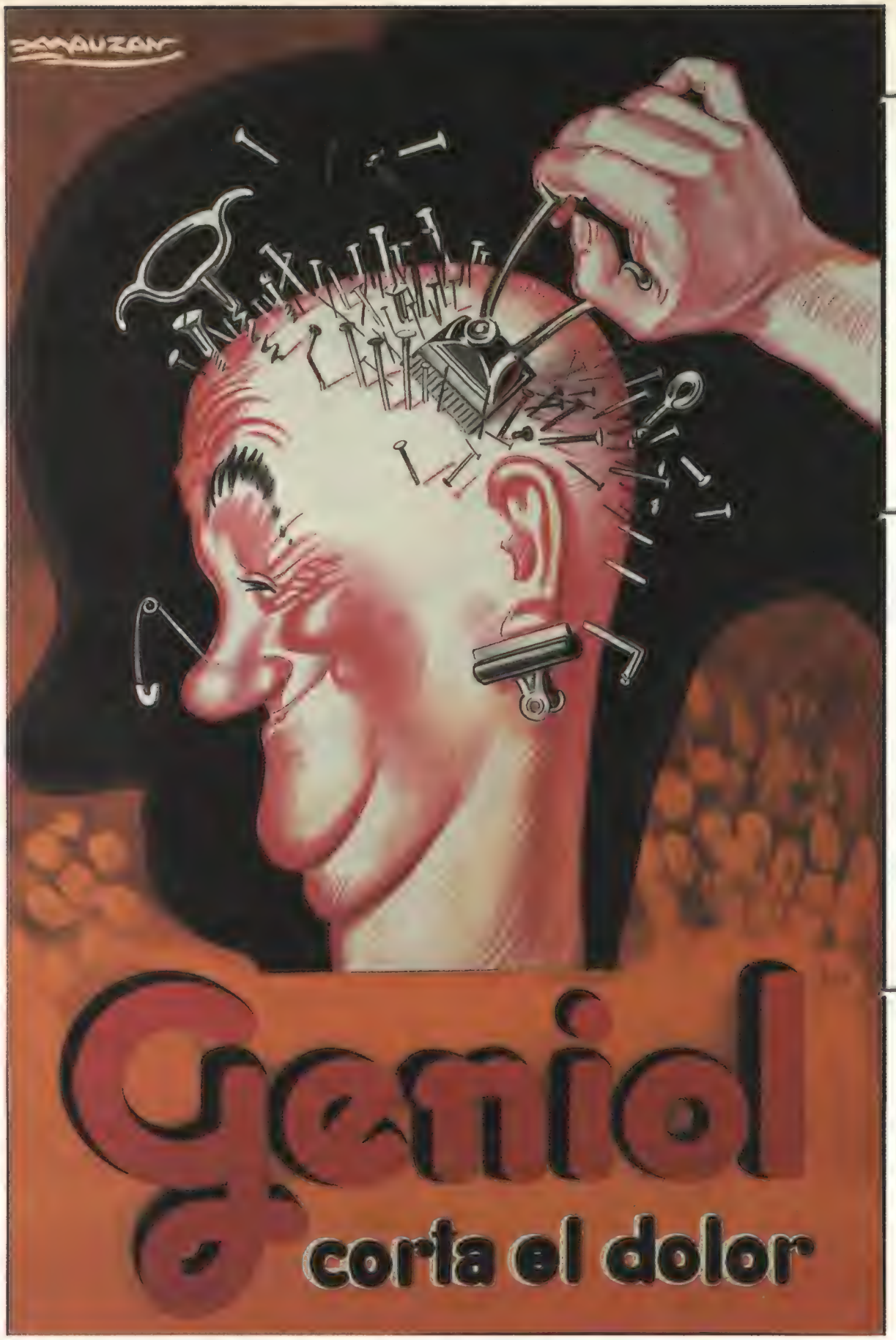

In a 1930s work by the French artist Lucien Mauzan, the patient smiles as pain-producing hardware is clipped away.

or "half a skull," because many attacks localize on one side. The name was later corrupted into the Old English megrim and eventually into migraine.

Classic migraine is both spectacular and unmistakable. It announces itself about a half-hour before the headache with a dazzling warning called an aura. The victim "sees" sparkles or stars or luminous wavy lines as though a photographer's flashbulb had just exploded; or, most common, a "fortification spectrum," a zigzag pattern like the parapets of a medieval walled city (p. 184).

Although many people equate "migraine" with "severe," the pain actually comes in degrees from mild to savage. In its most extreme form, it strikes like a sledgehammer on one side of the head, causing a throbbing,

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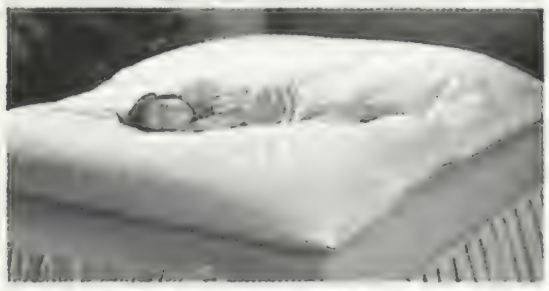

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pounding, pulsating pain. An artery may actually be seen thumping in the temple. The victim becomes pale, clammy, nauseous and may vomit, hence General Grant's "sick headache." Bright light intensifies the pain and drives many migraineurs to a dark room until the attack ends. A lucky few recover within hours, but others are laid low for days.

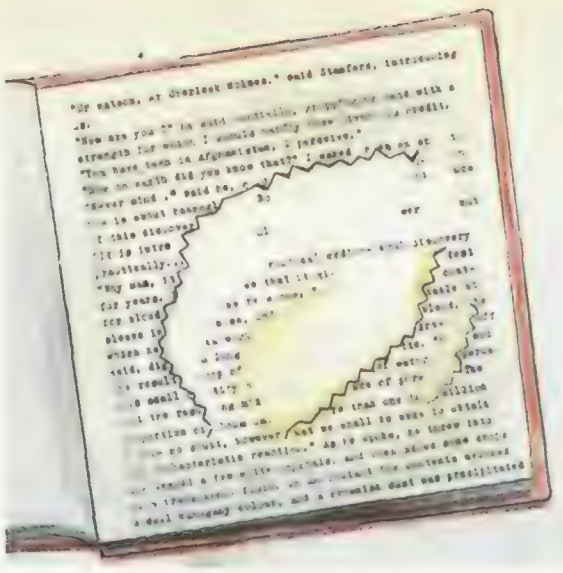
Common migraine, which accounts for four-fifths of migraine, produces fewer fireworks but can be even more painful. It lacks the warning aura and more often involves both sides of the head. Like the classic form, it strikes at intervals—several times a week to several times a year.

Migraine runs in families. About 70 percent of migraineurs have migrainous relatives. It can also begin early in life, even in 2- and 3-year-olds. Among adults, 70 percent of victims are women, mostly in the childbearing years.

Although migraines often strike out of the blue, they may be touched off in the susceptible by normally harmless stimuli. The list of migraine triggers includes food—cheese, chocolate, figs, red wine; bright lights (television, too); birth-control pills; abrupt changes of posture; shifts in weather; hunger; and the hot, dry winds of the desert.

Individual headaches, however, very seldom fit the scientific pigeonholes. Migraine not only varies from person to person, but from episode to episode. One person may have attacks rarely and irregularly; Ann Grimes could almost set her watch by hers. Commonly, a migraineur will have a one-sided headache with an aura during one attack, whole-head pain without an aura the next, and sometimes aura with no headache. Some victims, bewilderingly, have all the secondary symptoms of migraine—nausea, light sensitivity, clammy skin—but no head pain. And an unlucky few have both migraine and tension headaches, sometimes one after the other.

At this time there is no surefire



During a migraine attack, an artist drew the crenulated edges of a blind spot.

way to diagnose the commonest forms of headache except from the patient's own description. A migraine cannot be distinguished from a tension headache by any scientific measurement. Hence some doctors think the current classification system ought to be redefined. Others feel it ought to be dropped and headaches treated on a case basis. Neil Raskin, for one, suggests that all except "disease-related" headaches be lumped together as "benign recurring headache." "Headache represents a common pain syndrome," he says. "The symptoms we see are grouped on a continuum of severity from the mildest to the most severe, but the same pain process is occurring."

Arguments about the nature of headache are nothing new. In 1873 the distinguished British physician Edward Liveing published a treatise comparing the migraine aura to the nerve storm, or sudden electrical discharge, of an epileptic seizure. He was promptly contradicted by another prominent British doctor, P. W. Latham of Cambridge. Latham attributed migraine to a disturbance of the cranial blood vessels, and offered an explanation: "The sufferers possess what is called the nervous temperament; their brains are very excitable, their senses acute, and their imaginations free. The attacks are induced by prolonged mental work, protracted mental excitement, or any intense strain on the feelings." Migraine headaches, he confided, were

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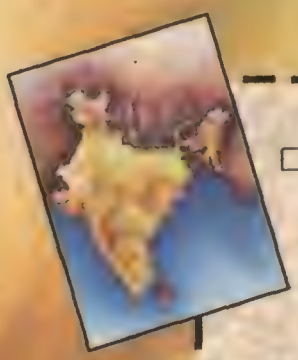

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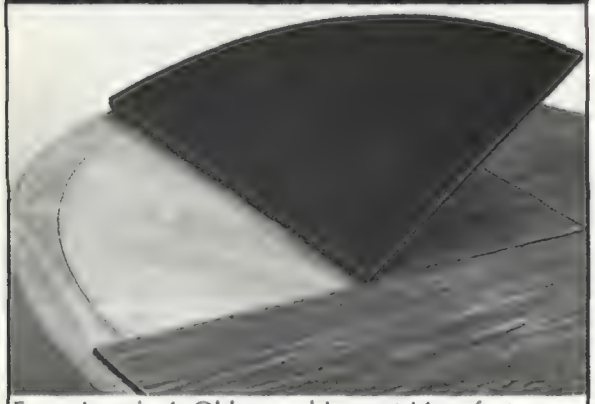

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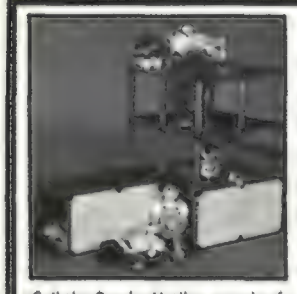

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More migraine art: zigzag crescent represents the "fortification spectrum," a typical visual disturbance, or aura, experienced by migraineurs.

quite common among Cambridge students during examination time.

Moreover, a horrified Latham chided Liveing, migraineurs and epileptics differed by "class." Epileptics, with their frightening "fits" and loss of consciousness, were shunned by society, whereas many migraineurs were prominent and wellborn.

Fellow neurologists sided with Liveing, but two developments caused Latham's views to carry the day. One was the dawning of the age of psychiatry; the other was the discovery of ergotamine: then known to act only on blood vessels, it was found useful in treating migraine.

The idea that migraine singled out only the best and the brightest was reinforced in the 1930s by Dr. Harold Wolff of the Cornell medical school, known as the father of modern headache research. Noting the throbbing temporal artery in some migraine attacks, he explained that migraine began when the arteries to the brain constricted, reducing the blood supply. Then came a compensating "overshoot" that distended the arteries until they stretched the nerve endings in their walls and produced pain. His research had shown, Wolff said, that brain tissue itself could not feel pain.

Wolff could find no physical explanation for these supposed ups and downs in blood flow, so, like Latham, he suggested a psychological one. Nine-tenths of his own migraine patients, he said, were perfectionistic, obsessive, driven go-getters.

For 30 years Wolff's idea that the precipitating factors in migraine were "all in the head" was scientific gospel. But in the mid-1960s revisionism set in. Dr. James Lance of the University of New South Wales, Australia, today one of the world's renowned headache experts, demonstrated that 25 percent of migraineurs were indeed obsessive, just as Wolff had said. But so were 25 percent of the general population. The U.S. National Health Survey uncovered no link between chronic headache sufferers and either intelligence or career success. Quite the contrary, another study showed: headache increased as you went down the socioeconomic scale. Researchers reached the obvious conclusion. The movers and shakers didn't have more migraines. They were just better able to afford treatment.

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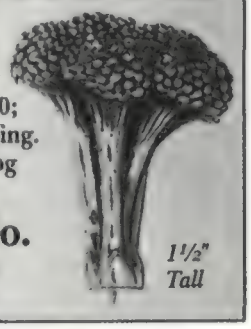
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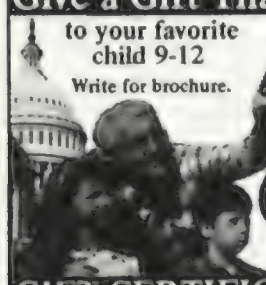

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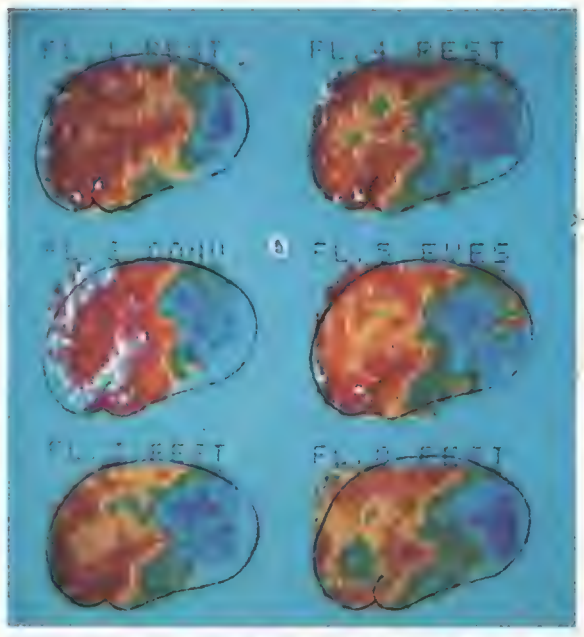
Meanwhile, the long-eclipsed hypothesis of Dr. Liveing began to stir again. In the early 1940s Harvard neurophysiologist and migraineur K. S. Lashley postulated that there was a wave, a phenomenon unknown at that time, which moved slowly across the cortex during an attack and which had a deadening effect on nerve-cell activity in the part of the brain controlling vision. In 1944 a Brazilian scientist, Manolo Leao, actually produced the event in the laboratory. He showed that a similar reduction in brain activity, including lowered blood flow, could be induced in laboratory cats. Starting from the rear, the nervous-system depression would slowly advance across the brain surface at two to three millimeters a minute, just as Lashley had said.

The "spreading depression of Leao," however, remained largely ignored for 40 years by a research community that considered headaches psychosomatic and the accompanying pain a circulatory problem. Then in the early 1980s, Danish scientists accidentally discovered alterations in brain blood flow during classic migraine attacks that resembled Leao's phenomenon. Neurologist Jes Olesen (p. 188) and research fellow Martin Lauritzen of the University of Copenhagen found that when patients susceptible to classic migraine underwent angiography, a process of injecting dye into the arteries, a migraine attack ensued. Addition of a radioactive tracer enabled them to record blood flow at ten-minute intervals at 254 points within one hemisphere of the brain. The full-color pictures produced (right) showed unmistakably that the aura coincided with at least a one-fourth drop in blood flow at the back of the brain and that this "depression" moved forward in a manner similar to the depression of Leao. Moreover, the back-to-front depression spread like a relentlessly advancing wave, rather than following the spiderweb pattern of arterial blood circulation. The phenomenon appeared to originate in the nervous system.

These scientists also made another startling finding. The spreading depression of cerebral blood flow occurred *only* in classic migraine. Victims of common migraine showed no such disturbance.

Olesen and Lauritzen's discovery of a nerve storm moving across the brain was the dramatic piece of evidence that convinced many researchers that Liveing was correct a hundred years ago.

While researchers differ on details, today's most widely accepted hypothesis for the problems of General Grant and Ann Grimes centers on the neurotransmitter serotonin, one of the not fully understood brain chemicals whose minute secretions signal nerve cells when to fire and when to cease firing. Serotonin is usually an "inhibitory" transmitter, meaning that it switches off nerve impulses. Researchers have known for 20 years that serotonin levels in the blood decrease during a reported migraine attack. There is speculation that the sequence of aura and pain may indicate that certain brain circuits are suddenly and inexplicably starved for serotonin, with consequent disorder in their normal function.



Growing area of decreased blood flow (blue) often precedes a migraine attack.

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Reminiscent of a scene from *Hamlet*, Dr. Jes Olesen uses a plastic model of the brain to discuss waves of nerve activity.

But what makes the head hurt? "One thing seems sure to me, that Wolff's old idea of scalp arteries pressing on nerves is clearly wrong," Neil Raskin says. "If that were the case, we would have a headache after every hot bath or every run around the block." Arteries often do swell during a migraine, Raskin says, but that may be an effect rather than a cause. And Olesen's brain scans were unable to show an overshoot in blood flow after the aura, as the swollen blood vessel theory required.

More likely, the pain centers in disturbed serotonin-controlled circuits deep in the midbrain. Support for this idea comes from unexpected results of medical treatment for pain elsewhere in the body. Dr. Raskin found that using electrical stimulation of the midbrain to relieve pain in the lower back caused headaches similar to migraine in some patients.

An alternative explanation is offered by Dr. Michael Moskowitz of Harvard. He suggests that neurotransmitters in the trigeminal nerves cause the blood vessels to become pain sensitive and inflamed. These highly sensitive nerves are also the villains in toothache, earache and sinus infection.

What sets off the process in the first place? Probably chronic-headache sufferers are born with a deficiency in neurotransmitter production, Raskin suggests. Just as some persons are prone to motion sickness, sufferers inherit a lowered tolerance for specific migraine triggers in amounts that the less vulnerable would shrug off. Susceptibility is a matter of degree. "I'm fairly well convinced that anyone can develop a vascular headache if the challenge is great enough," Raskin says.

While the research goes on, doctors have to treat headache sufferers now. The first line of treatment continues to be drugs. From the early 1930s until very recent years, the drug of choice has been ergotamine, which is a derivative of ergot, a substance whose history goes back almost as far as headache itself. Ergot, a fungus, was known in the Middle Ages; peasants who ate ergot-contaminated grain developed St. Anthony's fire, a tingling and burning in the ex-

"Still–in a way–nobody sees a flower–really–
it is so small–we haven't time–
and to see takes time, like to have a friend takes time."
—Georgia O'Keeffe

Red Poppy, 1927 *Oil on canvas 7" × 9", Private collection, Geneva*

Photography by Malcolm Varon

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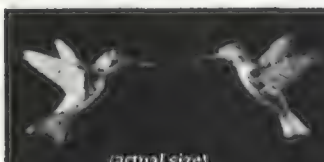
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tremities that could lead to dry gangrene. About one in five victims died and many lost their limbs. Ergot did its dirty work by constricting the blood vessels and reducing circulation to the feet and legs. The modern form similarly constricts the blood vessels, but doctors do not yet know exactly how ergotamine works, though it liberates the headache victim in more than half of all cases.

In recent years there has been a shift from ergotamine to nonsteroidal anti-inflammatory drugs, which can be equally, if not more, effective and which have fewer side effects. Several other drugs have been found to help prevent migraine headaches, including the beta-blocking drugs used to treat coronary artery disease and hypertension, and the calcium-channel blockers, also used in cardiac ailments. Methysergide, a relative of LSD, is sometimes used in acute cases, but only as a last resort because of its serious side effects.

Drugs are no longer the only treatment for headache, however. Since the late 1960s, the Menninger Foundation in Topeka, Kansas, has been experimenting with nondrug treatments. The basic method has been biofeedback. Patients are taught to increase blood flow to their hands to deflect it from the cranial arteries and reduce pain. There is considerable debate, however, about the effectiveness of such techniques.

Psychotherapy for headache has been tried ever since the days of Harold Wolff's migraine personality. But even a confirmed Wolff disciple, Dr. Arnold P. Friedman, founder of the Headache Unit at Montefiore Medical Center in New York, has called the results disappointing.

Yet clinicians remain ahead of researchers. "It is astonishing how successful we have been in treating headache without really knowing what pain is or being able to define accurately how drugs can relieve it," Friedman once wrote. Ulysses S. Grant knew that, and so does Neil Raskin. Good news helped the general eliminate a headache and, according to the doctor's research, so will falling in love.

Demons employ everything from hot pokers to raucous singing to give 19th-century victim a headache in etching by George Cruikshank.

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Book reviews

They All Laughed at Christopher Columbus: Tales of Medicine and the Art of Discovery
Gerald Weissmann, M.D.
Times Books, $17.95

These fine, provocative essays from the realms of medicine are difficult to describe in a few words. Dr. Gerald Weissmann, who has been sending us his dispatches from the front lines of New York's Bellevue Hospital for some years now, seems to write about almost anything that comes within his purview, from illness to art, cuisine, architecture and marine research. Yet his reflections on these seemingly disparate topics are closely if subtly linked to his major concern: the relationship between our science and our culture.

Picture the doctor turning for a moment from a desperately ill patient to gaze out the hospital window. He considers the yellow-eyed drug pusher of First Avenue and is reminded that although he will treat his patient with five wondrous drugs, she will die; for he cannot treat the social conditions that caused her illness. "That sort of discordant experience, of social muddle in the midst of scientific progress," Weissmann writes, "is an everyday burden to the clinicians among whom I work and whose philanthropic views I share."

For courage and solace, Weissmann looks to Christopher Columbus. Columbus, Weissmann tells us in the fascinating title essay, suffered from an agonizing condition known as Reiter's syndrome, which can cause severe arthritis and inflammation of the eyes, and reduced the great navigator to a half-blind invalid in his last years. Columbus persevered, nevertheless, using others to see for him and inhabiting a "kind of doghouse" on the afterdeck for his final voyage because he could not move about. Interestingly, Weissmann believes the condition accounted for Columbus' later errors.

Weissmann, who is a professor of medicine as well as a researcher, is understandably optimistic that technology will ultimately triumph over many plagues, including AIDS—but only if social conditions permit.

In "The Text in Context," the author turns again to history to illustrate the interrelationship between social attitudes and scientific thought. His example is a 17th-century debate over the development of human life. In one view, the fetus was thought to originate fully formed from the male; in the other, from the female. In both arguments, the second partner served a lesser function akin to watering or fertilizing. The reason that debate formed along these lines? Because at the time, an equal role for both sexes could not have been

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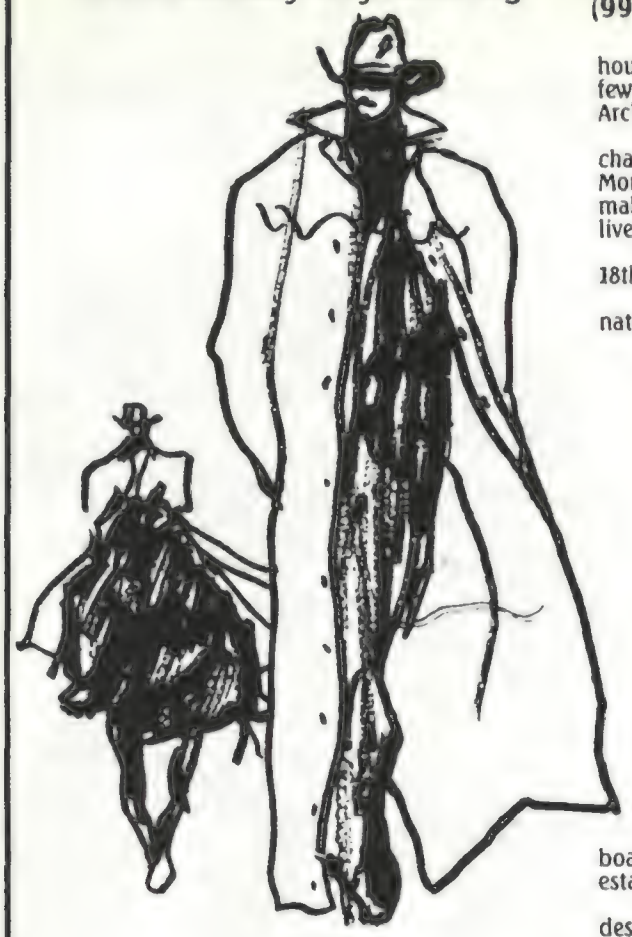

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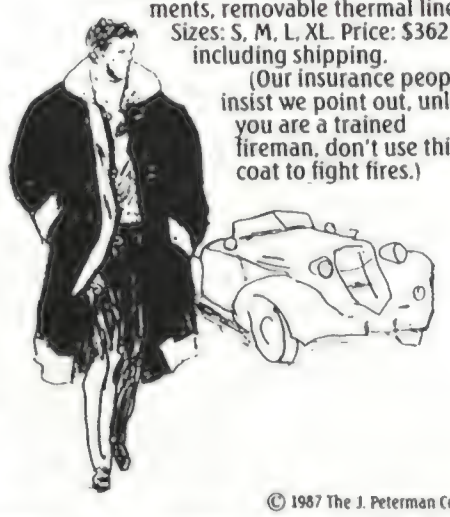

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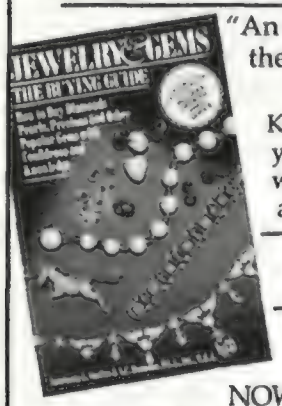

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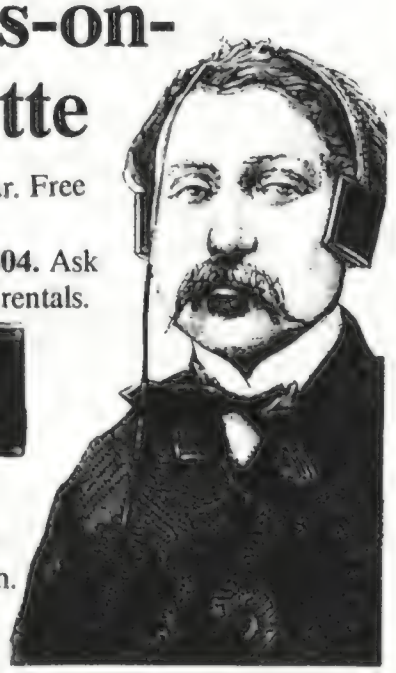

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imagined. The lesson Weissmann extracts is that the "more a scientist has learned about his society, the easier it is for him to understand how its conventions shape his ideas."

In his ruminations on these and many other topics, Weissmann draws on history, literature and art, on Voltaire, Freud, Heidegger, Proust, Whitman, Arendt and other varied sources from fashion magazines to Nazi medical journals. He is a graceful, original writer, as fans of his first collection of essays, *The Woods Hole Cantata*, know, and possesses a rare gift: he enlightens as he entertains. These are essays to read, mull over and read again.

There is no doubt that Voltaire, the great essayist, would approve. True authors, Voltaire said, are "those who have succeeded in a genuine art . . . and who teach and delight mankind. The others are among men of letters like bats among the birds."

Carol Eron
Author of *The Virus That Ate Cannibals*

Don't Tread On Me:
The Selected Letters of S.J. Perelman
Edited by Prudence Crowther
Viking, $19.95

"I can't write down to any special audience," protested American humorist Sidney Joseph Perelman in 1952, after *Redbook* magazine had tampered with his prose; "like any writer with self-respect, I've spent a good many years perfecting my tools and evolving a point of view and a manner that is characteristic." Indeed, he had—the manner of a wisecracking Jewish cosmopolite who is repeatedly buffaloed by the absurdities of 20th-century life and especially by his own well-meaning ineptitude. It was a manner that suited one magazine perfectly: the *New Yorker*, which published his "casuals" (their misnomer for humorous sketches and stories—in reality a most demanding form) for more than 40 years.

For the most part these letters sustain the Perelman pose. There are occasional digressions into seriousness. For his collegiate daughter he prescribed a dose of Mark Twain as an antidote to Dostoevsky after a reading of *Crime and Punishment* gave her the blues. After his wife died, he admitted to suffering from "periods of despair and frustration." But the typical letter in this collection amounts to the chaffing, punning, alluding performance that Perelman's public expected.

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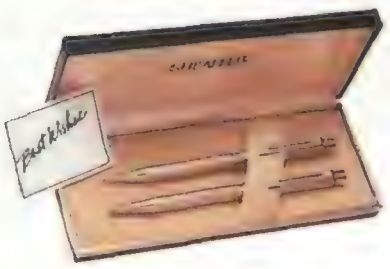

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raciness. American mores, if not the *New Yorker*'s caution, kept his published work on the safe side of suggestive, but in these letters he frequently indulges himself. Here is an innocent example: "Pennsylvania at the very moment has skies quite as lowering as Sligo's, the weather coolish and rainy and the grass breast-high. (Sophia Loren's that is. I recognize no other unit of measurement.)"

He knew practically everybody: T. S. Eliot, Cary Grant, Dorothy Parker, Charlie Chaplin, Lillian Hellman. He might pen the salutation "Dear Groucho" one day (Perelman wrote gags for the Marx Brothers in the 1930s) and "Dear Edmondo" (to Edmund Wilson) the next. He gossiped trenchantly about the exasperating film producer Mike Todd, for whose magnum opus, *Around the World in 80 Days*, Perelman polished the screenplay. "This sinister dwarf who consumed nine weeks of my life has no peer in his chosen profession, which—stated very simply—is to humiliate and cheapen his fellow man, fracture one's self-esteem, convert everybody around him into lackeys, hypocrites, and toadies, and thoroughly debase every relationship, no matter how casual. His enormity grows on you like some obscene fungus."

The *80 Days* assignment stemmed from his own status as a world traveler, which he exploited in such books as *Eastward Ha!* Late in life he moved to London with the intention of staying, but pined away for salty American speech and returned home. Back in the States, he reveled in the acquisition of new slang, writing to one friend that so-and-so had "freaked out" and to another that a car had been "totaled." Before his wife's death, you would have found him at his Manhattan digs or his Bucks County, Pennsylvania, farm.

By the time he became friends with Prudence Crowther, then an aspiring young humorist, he had consigned himself to a residential hotel—a move that "seemed proper," she judges, because there "he stood a greater chance of being abused in a stimulating way than if he'd lived entirely by himself." That note of affectionate teasing is characteristic of Crowther's introduction to the volume, and she deserves kudos for tracking down letters from an impressive number of correspondents.

Raymond Chandler once chastised Perelman for squandering so much good material in his letters—a sure sign of a truly fecund imagination. So it is

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only fitting to close with a passage that showcases the great man's earthy erudition and self-deprecating wit: "There were moments during the [Ford-Carter Presidential] debates when I fell into a catatonic state where my breath hardly frosted a mirror and I awoke to find my legatees gathered around me, rubbing their hands expectantly as they waited for my will to be read." They were probably anxious not so much for the money as for the codicils of mirth Perelman's will was bound to include.

Dennis Drabelle
Washington writer and reviewer

Wallace Herndon Smith: Paintings
Lee Hall
Academy for Educational Development and University of Washington Press, $19.95

Some dozen or so years ago, the Southern Illinois University Press began an occasional reprint series, Lost American Fiction. The novels and short-story collections were generally good, generally never heard of before by most people, and the project was a perfect example of what a university press ought to do.

Now the University of Washington Press in Seattle is doing the same thing for American artists who share the same unhappy fate of being unknown. The new series could be titled Lost American Art. This first volume establishes the standards: an unknown or underappreciated artist of the past or present, generous and excellent reproductions of the work—68 color plates and 32 black-and-white illustrations on 10½-by-9-inch pages—and a highly sensitive text combining the life and the works. Also the usual scholarly apparatus.

The New York-based Academy for Educational Development was the inspiration of the late Dr. Alvin C. Eurich of the Ford Foundation. It was created 26 years ago. Lee Hall, one of the youngest college presidents in the country when she was at the Rhode Island School of Design, is senior vice president in charge of the academy's Office of Arts and Communications, which originated this book and the project as a whole.

Wallace Herndon Smith is an ideal first subject for the series. I'd never heard of him in a life spent looking at art, most of it 20th-century American. He painted reasonably well. These are very pleasant pictures all the time and occasionally they have a little something extra: quietly powerful composition in a view of a village center in southern France, the air of nonsinister mystery in the picture of a lone man on horseback riding past a reservoir on a Connecticut country road.

This ineffable extra quality is not consistent. What is consistent is the true drawing, the very attractive use of muted color harmonies and the strong sense of place, whether in France or in the various parts of America where Smith lived and worked for almost six decades of active painting.

The life story interwoven with the painting is fascinating in itself. Smith was rich by birth, his mother a St. Louis Brookings, as in the philanthropic family and the Washington, D.C. research institution, himself a sharer in a family fortune made in lumber and banking. There was never a choice to be made between painting and eating. He ate very well and lived very well—perhaps too well, not in the sense of living it up, but in that of not

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having to live it down. He was clearly talented. He was accepted as a colleague by some of the best artists of his generation, including Raphael Soyer, Alexander Brook (with whom he studied), Brook's wife, Peggy Bacon (with whom he taught), his fellow Missourian Thomas Hart Benton, Edward Hopper and Walt Kuhn (insofar as Kuhn accepted anyone).

And yet, unlike all these friends and colleagues, Wally Smith never quite made it into anything that approached the recognition they had achieved. He lived comfortably. In New York he worked daily in his Union Square studio, but resided on the upper East Side and eventually commuted to the studio from New Canaan, then as now a Connecticut exurb for the well heeled. When World War II came, it brought a moment of decision for Smith. He gave up on the New York rat race and returned to St. Louis. There he assumed the role of society playboy, swell dancer, ready wit and all-around idler, all the while continuing a nearly secret life as a dedicated painter. Arthritis ended his painting a few years ago, but in St. Louis and at his lakeside summer place in northern Michigan, he produced a full four decades of American realist painting, a little tempered by French softness, the whole body of work a revelation as if the '30s had gone on forever.

It is that long-hidden body of work that this book addresses. Lee Hall writes gracefully and sympathetically, without ever overestimating the achievement of her subject, yet "restoring" it to a place it never had in American art.

The questions raised by this artist's life are eternal and to be answered finally in the mind of the artist himself. He has led a long life and a happy one on two separate levels that met only in his double identity. He missed the game and he missed the anguish that has attended so many more-successful American painters of his generation and of the next. He grew up in an American art totally unaffected by fashion and, in his exile at home, he remained free from its fascination, no small achievement. He produced a large number of paintings that please the eye, many that lift the heart, and a totality that underscores the main line of American painting from 1825 to 1950.

This book at once exemplifies and justifies the series. May it prosper.

Frank Getlein
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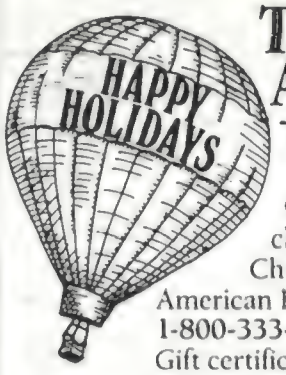

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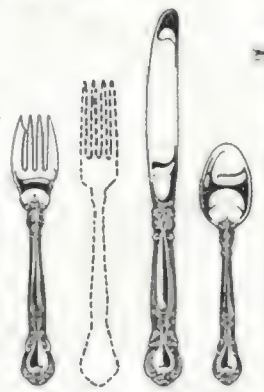
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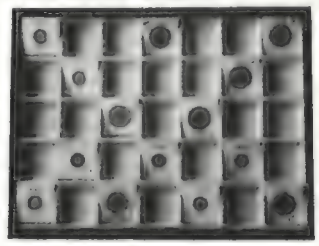

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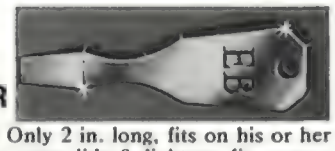

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and His Guardian" by Dorinda Evans, *American Art Journal*, Vol. XIX, No. 1, 1987

Roy Chapman Andrews (p. 94)
The New Conquest of Central Asia by Roy Chapman Andrews, American Museum of Natural History, 1932
Under a Lucky Star: A Lifetime of Adventure by Roy Chapman Andrews, Viking Press, 1943
Ends of the Earth by Roy Chapman Andrews, G. P. Putnam's Sons, 1929

Mazes (p. 108)
A Celebration of Mazes by Randoll Coate, Adrian Fisher and Graham Burgess, Minotaur Designs (St. Alban's, England), 1986
Mazes and Labyrinths of the World by Janet Bord, Latimer (London), 1976
Mazes and Labyrinths—Their History and Development by W. H. Matthews, Dover, 1970

Chaos (p. 122)
Chaos: Making a New Science by James Gleick, Viking Penguin, 1987
"The Mathematics of Chaos" by Gary Taubes, *Discover*, September 1984
The Dripping Faucet as a Model Chaotic System by Robert Shaw, Aerial (Santa Cruz, California), 1984
The Eudemonic Pie by Thomas Bass, Houghton Mifflin, 1985

Sleds (p. 138)
Carriage Terminology: An Historical Dictionary by Don H. Berkebile, Smithsonian Institution Press and Liberty Cap Books, 1978
Ice Sports by Theodore Andrea Cook et al., Ward, Lock & Company, Ltd. (New York), 1901

El Escorial (p. 152)
Philip II of Spain by Sir Charles Petrie, W. W. Norton, 1963
Philip II by Geoffrey Parker, Little, Brown, 1978
Building the Escorial by George Kubler, Princeton University Press, 1982
El Escorial by Mary Cable and the editors of the Newsweek Book Division, Newsweek, 1971

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Headache by James W. Lance, Charles Scribner's Sons, 1975
Headache by Neil H. Raskin and Otto Appenzeller, W. B. Saunders Company, 1980
Migraine by Oliver Sacks, University of California Press, 1985

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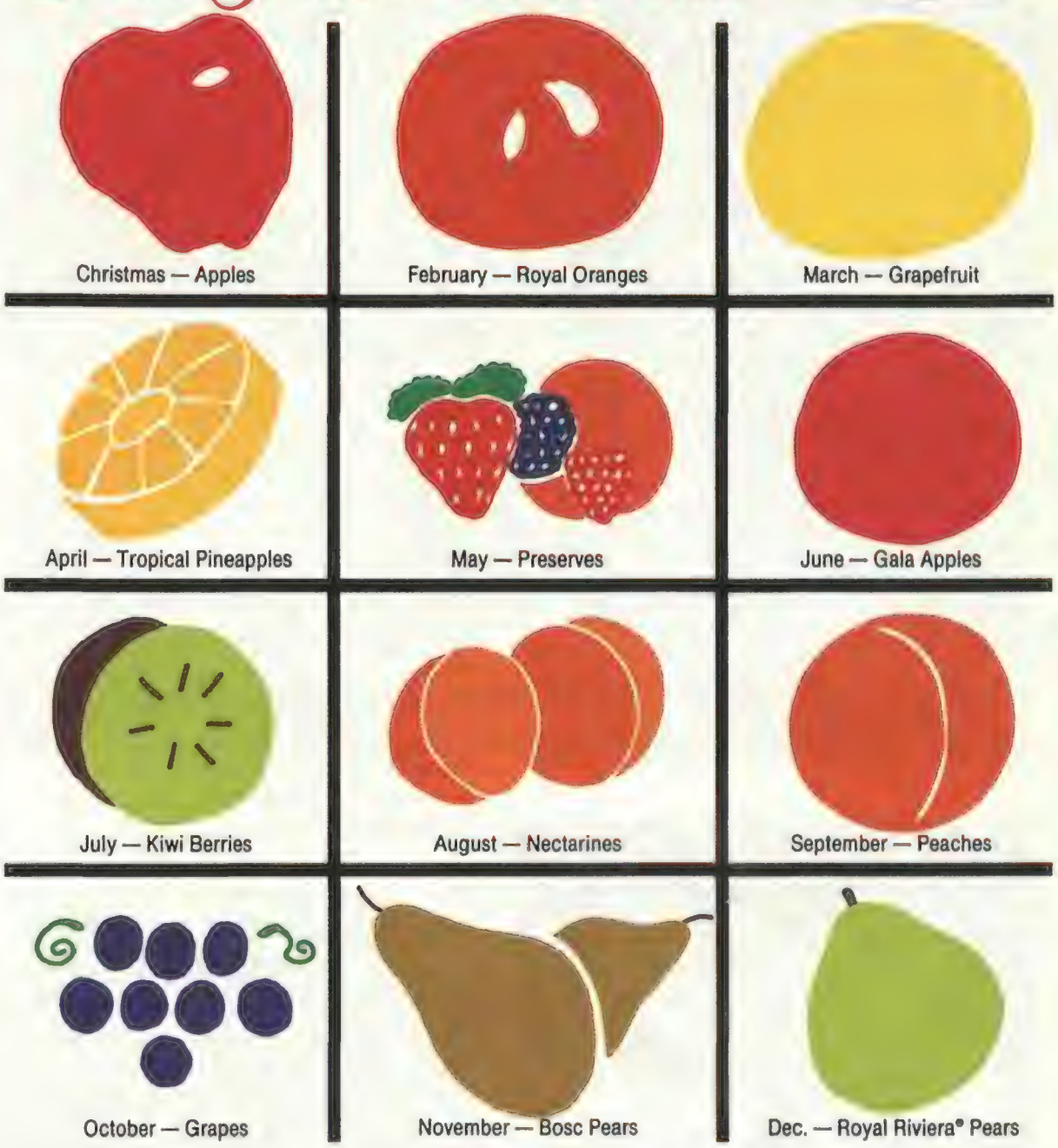

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Smithsonian highlights

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Special December exhibits and events

Cooper-Hewitt Museum (New York)
Surprise! Surprise! Pop-Up and Movable Books (through February 21) Subjects from anatomy to fairy tales. See *Highlights continued.*
Vienna/New York, The Work of Joseph Urban, 1872-1933 (through March 6) Architectural, set and furniture designs.

National Museum of African Art
Patterns of Life: West African Strip-Weaving Traditions (through February 29) A rich selection of textiles.
African Art in the Cycle of Life (through March 20) Sub-Saharan masterworks.
Royal Benin Art in the Collection of the National Museum of African Art (runs indefinitely) Traditional court art.

Arthur M. Sackler Gallery
In Praise of Ancestors: Ritual Objects from China (through 1988) Extensive collection highlights bronzes and jades.
Monsters, Myths and Minerals (through 1988) Animal imagery in 123 pieces.
Pavilions and Immortal Mountains: Chinese Decorative Art and Painting (through August 1988) Furniture, paintings, objects.

National Museum of American History
The Trees of Christmas (December 18-January 6) Ten theme trees decorated with handcrafted ornaments.
The Search for Life: Genetic Technology in the 20th Century (through March 30) Molecular biology—its history, its applications.

National Museum of Natural History
Birds and Flowers of the Fifty States: The Singer Stamp Series (through January 28) Paintings by Arthur B. Singer, one of America's foremost wildlife artists.

Anacostia Museum
Climbing Jacob's Ladder: The Rise of Black Churches in Eastern American Cities, 1740-1877 (through March 20) One hundred fifty illustrations and artifacts.

Hirshhorn Museum & Sculpture Garden
Directions—Joel Shapiro: Painted Wood and *Sol LeWitt Works* (December 2-February 28) The first two exhibitions of a newly launched series.
The New Spirit: Artist Organizers of the Armory Show (December 21-March 13) A commemoration of the 75th anniversary of America's modern art blockbuster.

National Portrait Gallery
Studies from Life: Portrait Photographs by Julia Margaret Cameron from the J. Paul Getty Museum (through February 7) Works by the masterful 19th-century photographer.

National Museum of American Art
Supreme Instants: The Photography of Edward Weston (December 1-January 31) A retrospective of work by one of the most important 20th-century photographers.

Renwick Gallery
Cynthia Schira: New Work (through February 14) Ten large-scale weavings.
Lost and Found Traditions: Native American Art 1965-1985 (through March 6) An enduring artistic legacy.

National Air and Space Museum
Voyage to Venus: The Mission of Mariner 2 (December 10; 8 P.M.) Lecture by Dr. Carl Sagan of Cornell University, part of special public program commemorating 25th anniversary of Mariner 2 mission. For details call 357-2700.
U.S. Customs Service: The War Against Drugs (December 18-runs indefinitely) Aircraft, techniques used by the U.S. government for interdiction of contraband.

Exhibition catalogs

Catalogs available at this time include:
Asian Art in the Arthur M. Sackler Gallery: The Inaugural Gift (paper, $24.95)
Supreme Instants: Photography of Edward

Weston (paper, $22.50; cloth, $50)
Generations: A Universal Family Album (paper, $18.95; cloth, $35)

To order, send check or money order to Museum Shops, Box 44083, Washington, D.C. 20026-0083. Include 15 percent of total purchase to cover postage and handling (minimum, $1.75).

Smithsonian on the air

Radio Smithsonian: Features on this weekly half-hour series include a dialogue with violinist Isaac Stern, a rare look into the Soviet scientific community and highlights of a new exhibition of movable and pop-up books.
Here at the Smithsonian: Three-minute TV features present the unveiling of the Institution's newest museums.

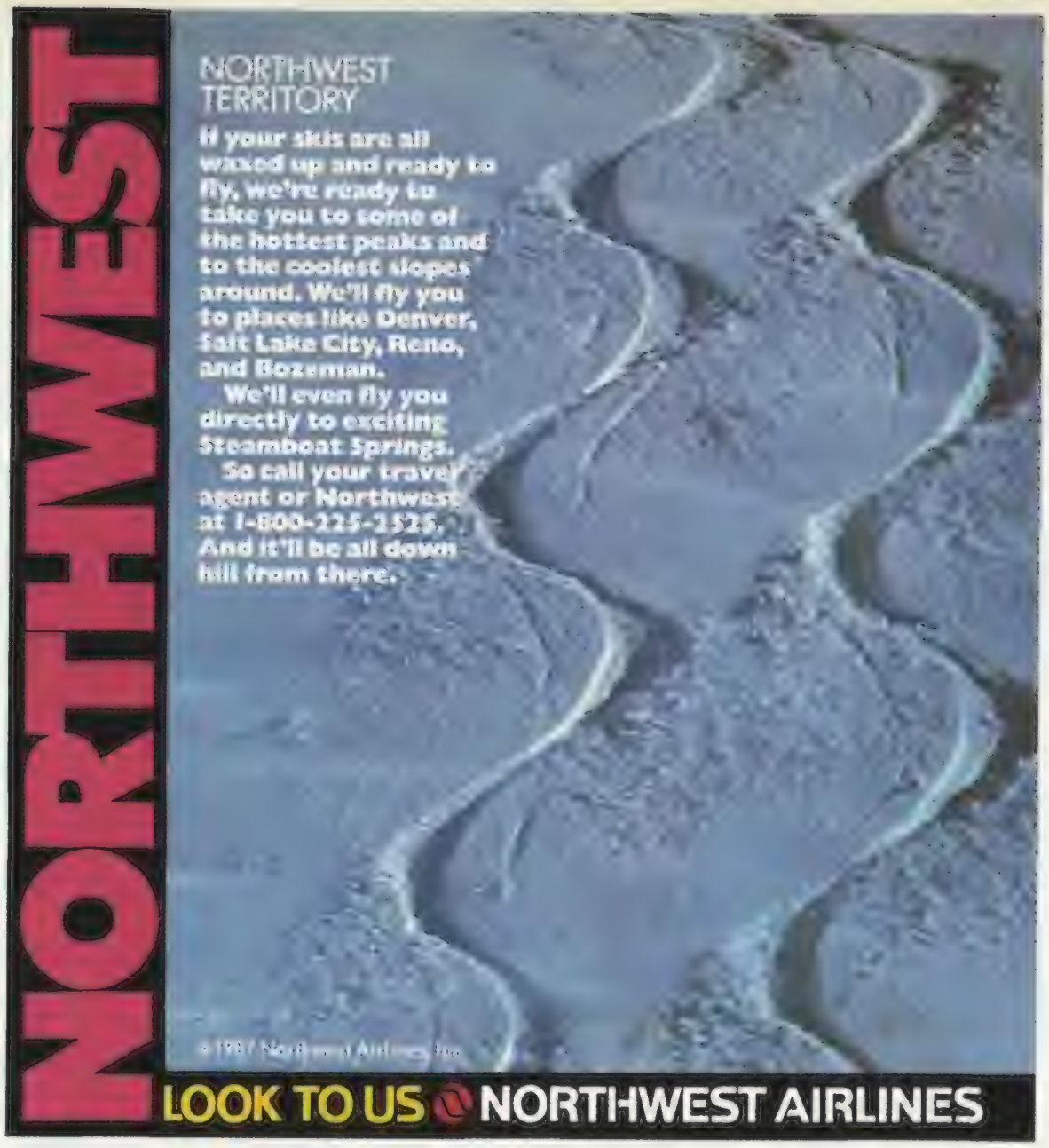
To find out what stations in your area carry these programs, write Office of Telecommunications, MAH Room BB40, Washington, D.C. 20560.

Resident Associate Program

To become a Resident Associate, or for fee and ticket information, call 357-3030. Here are some December events:
A Festival of Canadian Cinema (November 30, December 7, 14; 7:30 P.M.) Recent works by some of Canada's finest filmmakers.
Superconductivity's Ice Breaker (December 8; 8 P.M.) Houston physicist Dr. Paul Chu explains breakthroughs in superconductivity research.
Amsterdam Guitar Trio (December 5; 7 P.M.) Internationally renowned guitar trio from Holland in a holiday salute.
Professional Ethics and America's Crisis of Conscience (December 5; 10 A.M.-6 P.M.) Eminent scholars raise questions about the place of ethics in our culture.

Smithsonian Institution Traveling Exhibition Service

SITES circulates exhibitions to hundreds of cities outside the Washington area. To sponsor one of the shows in your community, write SITES, Smithsonian, Washington, D.C. 20560. Here are some December exhibits:
District of Columbia (December 5-January 17) *A Russian Impressionist: Paintings and Drawings by Leonid Pasternak, 1890-1940*, Meridian House International.
Los Angeles (December 5-February 22) *Hollywood: Legend and Reality*, Natural History Museum of Los Angeles County.
Seattle (December 12-January 10) *After the Revolution: Everyday Life in America, 1780-1800*, Seattle Public Library.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Books that won't sit still

A new exhibit at the Cooper-Hewitt invites the viewer into the surprising world of pop-up and movable books

A bat darts out of the dark, a hawk lights on the peak of a cactus, clowns cavort, children play, horses prance, Superman emerges from a telephone booth and King Kong teeters on the top of the Empire State Building. A circus? A festival? A happening? A museum? You'll find a little of each at "Surprise! Surprise! Movable and Pop-Up Books," a new exhibition that opened recently at Smithsonian's Cooper-Hewitt Museum in New York City.

"These books are so entertaining," says Cooper-Hewitt librarian Katharine Martinez, who curated the display, "and they communicate as well as delight. The first uses of mechanical books were for scientific instruction. They're wonderful for getting across a complex visual message."

The exhibit spans the 16th through 20th centuries—from a volume on astronomy printed in 1551, with revolving disks and pointers showing the movement of the Universe, to an "adult" offering of the 1960s with a can of Hunt's tomato paste (painted by Pop Art star Andy Warhol) that literally pops up off the page. A video presentation captures selected illustrations as they are brought to life with the turn of a page or the pull of a tab, and the complicated process of design and production is demonstrated from first sketch to finished product.

Martinez views the 1980s as a renaissance of the golden age of mechanical books of the late 19th century—an era made possible by new technology for fast, economical color printing. Now, in the 1980s, advances in paper engineering and in production have led to the creation of extraordinarily complex three-dimensional books that are affordable, available and continue to delight an ever wider audience.

Surprising, engaging and informative, about 85 books will be on display through February 21.

Diane M. Bolz

Victorian children frolic in publisher Ernest Nister's *Pretty Polly*, c. 1890.

Paper circus was created by movable-book genius Lothar Meggendorfer c. 1904.

Creatures of the Desert World, published by the National Geographic Society in 1987, is tour de force of illustration and paper engineering.

One-of-a-kind artist's book by Paul Johnson was made especially for show.

The Human Body, 1983, is one of the most successful pop-ups ever published.

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Domestic Study Tours

Florida Springs February 6-10: Canoe the freshwater springs of central Florida and see the endangered West Indian manatee.

Hawaii February 6-18 or February 20-March 3: Experience undersea wonders, great volcanoes, lush forests and whale watching.

Death Valley & East Mojave Desert March 9-18 or April 8-17: Explore these wilderness areas by van. Visit Scotty's Castle, photograph desert flowers and hike to scenic overlooks.

Sojourn in Tucson April 3-10 or April 25-May 2: From your base at the Arizona Inn, settle in for a weeklong overview of Arizona's cultural and natural history.

Alabama April 9-16: Discover the South's rich cultural heritage as interpreted by scholars, craftsmen and musicians.

Southwest Indians April 29-May 8: In this in-depth look at Southwest Indian cultures, travel to Phoenix, Chaco Canyon and Canyon de Chelly. Meet craftsmen, visit museums and private collections.

Spring Gardens May 8-15: On this new tour, enjoy a variety of gardens in Washington, D.C. and the Delaware Valley including the Smithsonian's Enid A. Haupt Garden, Longwood and Winterthur.

San Francisco May 14-21 and September 3-10: Experience the ambience and charm of this popular destination while visiting sites beyond the usual tourist route. An overview of the city's history, ethnic diversity and future prospects.

Atlantic Quest May 20-June 4: Aboard the *Illiria*, retrace America's history on this unique voyage from New Orleans to Campobello Island in New Brunswick.

Sanibel Island May 22-28 or May 29-June 4: Tidal walks and canoe journeys take you in search of alligators, roseate spoonbills and loggerhead turtles in this estuarine environment on Florida's Gulf Coast.

Wild California—Big Sur to Yosemite June 8-17 or September 9-18: Sea breezes, ancient redwoods and lush mountain meadows await you on this natural history tour of California's most spectacular landscapes.

Washington "Anytime" Weekend Discover your capital city in Smithsonian style with this economical package. Visit the new Quadrangle complex which contains the Museum of African Art and Sackler Gallery. Arrive any day during the holiday season.

Foreign Study Tours

People's Republic of China Follow the Silk Road, climb sacred peaks, cruise the Yangtze, travel by train, study decoration and antiques or visit Tibet. Tours for new and repeat China travelers.

Christmas in Europe Celebrate with fellow Associates in one of four idyllic settings: Munich and Rothenburg; Salzburg and Vienna; Canterbury; or Winchester.

Backstage London January 1-10: In Europe's theater capital, attend traditional and avant-garde productions, meet performers backstage.

South America Voyage January 7-31: Cruise from Brazil through the Strait of Magellan and Beagle Channel to Santiago, Chile. Fly to Iguaçu Falls.

Thailand-Burma January 9-29: In Asia's most exotic countries, visit colorful cities, remote villages and archaeological sites.

Mesoamerican Study Programs January and February: Choose from three itineraries —Yucatán Adventure, Zapotec and Maya Mexico, Guatemala Adventure. Explore archaeological treasures, natural beauty.

Tanzania-Kenya Wildlife Safari January 18-February 7: A unique wildlife excursion featuring the best of East Africa.

India Wildlife Safari January 22-February 17: Travel by elephant and jeep to observe rare species of birds and animals in India and southern Nepal.

Siberian Winter Odyssey January 24-February 6: A thrilling winter exploration awaits you—dash through majestic countryside in a troika, ride the Trans-Siberian Express, visit Moscow and Leningrad.

A Hike in New Zealand February 14-March 5: From Lake Te Anau to Milford Sound, discover wildflowers, crystalline lakes and snowcapped peaks on the Milford Track.

Australia-New Zealand February 21-March 15: An intriguing introduction to the natural history and culture of lands "down under."

Costa Rica March 11-24: An expedition for nature enthusiasts to see flora, birds and other wildlife in the American tropics.

Chile-Bolivia Voyage March 24-April 6: Aboard the *Illiria* travel up the coast of Chile. Explore archaeological finds, crystal clear lakes and the magnificent Atacama Desert. Fly to La Paz. End trip in Bolivia.

Caribbean Voyage March 28-April 4: Sail from the Panama Canal to Curaçao aboard the four-masted, square-rigged bark *Sea Cloud*. Calls include the San Blas Islands, Cartagena, Aruba.

Berlin April 14-29: Experience the two sides of Berlin, East and West, named Cultural Capital of Europe for 1988.

May in Greece May 6-21: Marvel at classical wonders and beautiful landscape from Athens to Thessaloníki.

Splendors of Italy May 6-23: Sail along the coast of Italy from Venice to Genoa aboard the chartered *Argonaut*. Excursions highlight art, architecture and gardens.

Shadows of the Past—Châteaux, Caves and Villages of the Dordogne May 14-27 or May 28-June 10: Discover this unique area of France. Tour includes Paris.

Istanbul & Beyond May 20-June 5: Five days in this stunning Turkish city followed by a choice of excursions to the Aegean Coast or central Anatolia and Cappadocia.

Florence Seminar May 28-June 13: Live in an elegant villa-hotel, study the Renaissance.

European Countryside Programs May-September: Reside in scenic and historic areas of Hungary, England, Austria, France, Italy, Switzerland, Germany, Wales or the Netherlands.

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Splendors of Asian Art
Trace the history of Asian art with scholars from the Sackler and Freer galleries. Enjoy lectures and tours that feature Chinese bronzes, decorative art and painting, Near Eastern metalwork and contemporary Japanese art. You'll also visit private and public collections of Indian and Tibetan art.

African Art at the Smithsonian
Discover Africa's rich artistic heritage as you tour the museum's permanent collection and special exhibitions ranging from West African strip-weaving to the royal art of Benin. Learn about the relationship between African sculpture and the rites of passage. Explore the variety of materials used to create beautiful utilitarian objects.

The Art and Craft of Creative Writing
Study the techniques of successful creative writing with Edwards Park, author of SMITHSONIAN's monthly column *Around the Mall and beyond.* Immerse yourself in the colorful range of activities at the Smithsonian museums and share your written impressions with classmates during daily discussion sessions.

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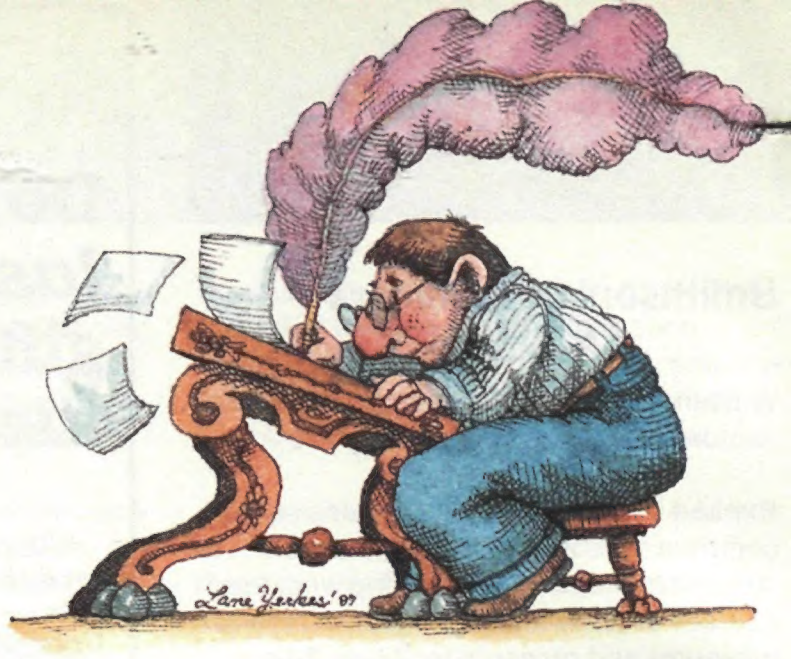
Learning one's letters from Mme. la Comtesse



I realized I was finally getting somewhere with my French when the countess barred the title on her calling card. There it was, no doubt about it: ~~*Comtesse*~~ *Antoinette de Quelquechose prays you to be willing to assist at cocktails.* The neat line penned through her title signified that, as of that moment, I was allowed to call her Antoinette instead of *Madame la Comtesse.* Wow.

This isn't merely a matter of social climbing, understand. My triumph was the simple fact that I understood what was going on there. To put things in plain English, I was beginning to comprehend the nuances of etiquette. I was breaking the code.

Ever since the mid-1600s, when Madame de Sévigné got lonesome hanging out with royalty in Paris and started writing letters to her troublesome daughter, the French have been incurably given to epistolary extravagance. If the English are notorious for deducing subtle differences of class from tiny details of accent and dress, they are only minor leaguers—in comparison to the French—when it comes to the written word. It has taken me years to learn that, on the Paris side of the Channel, nothing marks you as a lout faster than the slightest transgression of the ironclad rules of correspondence.

Oh, I easily recovered from the culture shock of snails with garlic. I hid my panic during my first drive, in heavy *circulation*, around the Étoile. Some sense of the civil war that over here passes for politics eventually came to me. But none of this could prepare me for the experience of receiving and sending letters.

It was not so much the content that shook me—the French are able to tell you that your checking account is overdrawn as succinctly as anyone else. (The blunt *Pas de Crédit* signs in bars and grocery stores were proof enough of that.) What was unsettling about these letters, even the simplest and most routine, was all that florid business at the end. For anyone accustomed to the good old "Yours truly," "Sincerely" or even the occasional, daring "Affectionately yours," Gallic good-byes are extraordinary, baffling, and, above all, protracted.

Take, for example, the one I soon identified as the simplest possible all-purpose bye-bye, the most casual wave of the epistolary hand: *Receive, Monsieur, the assurance of my sentiments the best.*

I liked it. It was like getting one of those groovy Errol Flynn, Three Musketeers-like bows, with flourishes of a feathered cap in place of a grunted "See ya later, man." Little did I know, though, in those callow days when my French was mostly up to telling people that the pen of my aunt was in the garden, that this was only the beginning. Poor wretch, how could I have known then that this mere *assurance of sentiments the best* signified in fact a subtle suggestion of superiority on the part of the letter writer? A salutation from equal to equal would require him or her to lay *distinguished* sentiments on me, or even *very distinguished* sentiments, if I were considered *very* equal.

Gradually, after years of letter reading, the winks and nudges became clearer and, though I'm not up to deciphering all of the courtly code, I can at least spot the moment when a countess, with a stroke of her pen, becomes Antoinette. I can also kiss off a tradesman, so to speak, with *my best salutations* or *fervent civilities.* If I really want to mark the distance that separates us, nothing beats the haughty old standby, *I have the honor to salute you.* Should you feel particularly democratic or, more likely, want to get on his good side, you can wing him your *devoted sentiments.* I do that frequently with my plumber.

It's more complicated, as you might imagine, when dealing with one's betters or highly placed folk from whom one wants something. You can't tell people like that to *receive* your *assurances.* You beg them to *recognize* your *expressions of respectful devotion* or *respectful sympathy.* If you're writing an ambassador it is safer to offer the *assurance* of your *very high consideration.* A cabinet director warrants a *most distinguished consideration* and his deputy director a *very distinguished consideration.* An attaché needs only *distinguished consideration.*

Naturally the French are in a class by themselves when it comes to ornate vituperation. Many times in conversation I have heard of the writer—although no one can ever agree on which writer it was—who prayed an enemy *to accept the expression of my sentiments perfectly contemptuous.* Touché!

I haven't yet had the occasion to write a king or a queen, but I know I'll have to implore them *to deign to recognize the assurance of the respectful consideration* with which *I have the honor to be, Your Majesty, the very humble and very obedient servant.* I'm not sure whether that one is OK for Prince Rainier of Monaco, whom I've been meaning to write about his daughters. I'll have to ask Antoinette.

Which brings me to the one that is the most delicate of all, *naturellement*: correspondence between men and women and vice versa. For a gent, the route from *most respectful hommages* via straight *hommages* all the way to the expression of his *most respectful sympathy* is fraught with pitfalls. For a lady, the same dangers apply with the passage of greetings—from the brusque, chaste *Monsieur* to *Mon cher* or even (whew) *Chéri.*

"If friendly relations become established," advises one guide to etiquette, "the formulas will be easier to find."

You can say that again. No, on second thought, don't.

Dear Bill,
A little something to improve my backhand.
Love, Elizabeth

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